CDM

U. S. Army Corps of Engineers
Philadelphia District

Final Sampling and Analysis Plan

Operable Unit 3
Blackwater Branch Investigation
Vineland Chemical Superfund Site
Vineland, New Jersey

USACE CONTRACT NO. DACW 41-02-D-0002
TASK ORDER NO. CF02

January 2005

US ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
LEADERS IN CUSTOMER CARE

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Prepared by:

CDM Federal Programs Corporation
Raritan Plaza I, Raritan Center
Edison, NJ 08818

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Contents

Introduction

Under the United States Army Corps of Engineers (USACE), Kansas City District, Contract No. DACW 41-02-D-0002, Task Order No. CF02, CDM Federal Programs Corporation (CDM) is conducting field investigation services at the Vineland Chemical Company Superfund Site (Site) located in Vineland, New Jersey on behalf of USACE Philadelphia District. The purpose of the field investigation is to delineate shallow sediment contamination along the Blackwater Branch portion of the Site, in the Operable Unit (OU)3 floodplain area. The ultimate goal of this investigation is to provide USACE with further understanding of the different soil strata and contamination levels in this area to help determine which portions of the OU3 contaminated materials can be excavated and treated by the on-site OU1 soil washing system/plant.

This Sampling and Analysis Plan (SAP), which contains a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP), is the governing document for the performance of the additional investigation work. This SAP outlines the specific field investigation, sampling, and quality assurance/quality control (QA/QC) procedures for the sample collection and analysis activities.

The FSP (Part A of the SAP) describes the field activities that will be performed and defines the procedures and methods that will be used to collect field data. The QAPP (Part B of the SAP) focuses on the analytical methods and quality assurance/quality control (QA/QC) procedures that will be used to analyze project samples, ensure the data are of known and acceptable quality, and manage the data.

US ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
LEADERS IN CUSTOMER CARE

FINAL FIELD SAMPLING PLAN

Operable Unit 3
Blackwater Branch Investigation
Vineland Chemical Superfund Site
Vineland, New Jersey

USACE CONTRACT NO. DACW 41-02-D-0002
TASK ORDER NO. CF02

January 2005

Prepared by:

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Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Section 1
Project Background

Under the United States Army Corps of Engineers (USACE), Kansas City District, Contract No. DACW 41-02-D-0002, Task Order No. CF02, CDM Federal Programs Corporation (CDM) is conducting field investigation services at the Vineland Chemical Company Superfund Site (Site) located in Vineland, New Jersey on behalf of USACE Philadelphia District. The purpose of the field investigation is to delineate shallow sediment contamination along the Blackwater Branch portion of the Site, in the OU3 floodplain area. This Field Sampling Plan (FSP) is part of the Sampling and Analysis Plan (SAP), prepared in accordance with the USACE EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans (USACE 2001)*. Additionally, all activities conducted under this SAP will be in accordance with CDM's Quality Assurance Manual, Revision 10 (CDM 2002a) as modified by the contract Quality Implementation Plan (QIP), Revision 0 (CDM 2002b).

1.1 Site Description and History

The Site is located in a mixed residential and industrial area in the northwest portion of the City of Vineland in Cumberland County, New Jersey. The site is bordered to the north by Wheat Road and the Blackwater Branch, a tributary of the Maurice River. Residential areas are located adjacent to and east and south of the site.

The Site contains the former Vineland Chemical Company plant, which manufactured arsenic-based herbicides from approximately 1949 to 1994, according to the U.S. Environmental Protection Agency (EPA) fact sheet. Prior to 1977, the company stored by-product arsenic salts on-site in open uncovered piles. The improper storage of these by-product arsenic salts led to arsenic contamination of subsurface soils and groundwater at the plant site, in addition to arsenic contamination of nearby surface waters and sediments, including the sediments in and around the Blackwater Branch, a tributary of the Maurice River.

By 1982, in response to New Jersey State actions, the Vineland Chemical Company instituted some cleanup actions and modified the production process. The modifications included the installation of a non-contact cooling water system, the lining of a lagoon, installation of a storm water runoff collection system, and disposal of several piles of waste salts. Also in 1982, the Vineland Chemical Company, under a State Administrative Order, began operation of a small on-site wastewater treatment system to remove arsenic.

In 1984, the Site was added to the National Priorities List (NPL). In 1989, EPA issued the Record of Decision (ROD) for the Site, calling for the cleanup of the Site in two stages. The first stage was an immediate cleanup action, performed in 1992 and 1993, consisting of the removal of hazardous materials stored on site and the boarding up of abandoned buildings. The second stage of the cleanup consists of the following four long-term remedial phases or operable units:

- OU1 - Plant Site Source Control: Remediation of arsenic-contaminated soil at the Plant Site, which is a continuing source of groundwater contamination, via excavation and soil washing.
- OU2 - Plant Site Management of Migration: Remediation of the arsenic-contaminated shallow groundwater to prevent migration to the Blackwater Branch, via groundwater pump and treat.
- OU3 – Blackwater Branch Sediment: Investigation and cleanup of the arsenic-contaminated flood plain soil/sediments in the Blackwater Branch of the Site.
- OU4 – Union Lake Sediments: Remediation of sections of the Union Lake with unacceptably high arsenic concentrations, via dredging.

Remedial activities for OU1 and OU2 are ongoing, with a soil washing plant and a groundwater treatment plant in operation at the plant site. The EPA had requested that the USACE provide technical assistance for the remedial design of OU1, and USACE is now performing construction management of the OU1 soil washing system being operated by the on-site remedial action contractor, Sevenson Environmental Services, Inc. (SES). For OU2, the USACE constructed a wastewater treatment plant in 1999 and 2000 to recover and treat the contaminated groundwater, which began operation in the spring of 2000.

This FSP, as part of the SAP, is for the performance of investigation tasks for the OU3 portion of the Site, the soil/sediments of the Blackwater Branch. For OU3, additional investigation is required to further delineate the arsenic contamination in sediments of the Blackwater Branch and adjacent floodplain. These additional investigations are also necessary to evaluate the effectiveness of the ongoing OU2 groundwater treatment on the soil/sediment concentrations within the Blackwater Branch. The ultimate purpose of the investigation is to gain an understanding of characteristics of the sediments of the Blackwater Branch/floodplain area to determine if portions of those contaminated materials can be excavated and treated by the existing on-site OU1 soil washing plant.

Section 2
Project Organization and Responsibility

2.1 Overview

The organization for the project (Figure 2-1) is designed to provide a clear line of functional and program responsibility and authority supported by a management control structure. The control structure involves the USACE Project Manager (PM), the EPA Remedial Project Manger (RPM) and the CDM PM. Overall responsibilities include:

- Establishing clearly defined lines of communication and coordination
- Monitoring of project budget and schedule
- Providing progress reports
- Quality control
- Health and safety
- Project coordination

The following personnel are assigned to this project:

EPA Remedial Project Manager	Ronald Naman
USACE Project Manager	Eric Charlier, P.E.
USACE Project Engineer	Steve Creighton
USACE Field Geologist	Mark Chamberlain
USACE Project Chemist/Analytical Coordinator	Erika McCormick
CDM Project Manager (PM)	Kershu Tan, P.E.
CDM Task Manager (TM)	Maria Watt, P.E.
CDM Quality Assurance Manager (QAM)	George DeLullo
CDM QA Coordinator (QAC)	Jeniffer Oxford
CDM Corporate Health and Safety Officer (CHSO)	Chuck Myers, CIH
CDM Site Health and Safety Officer (SHSO)	Stuart Barden
CDM Field Team Leader (FTL)	Stuart Barden
CDM Project Geologist (PG)	Stuart Barden
CDM Analytical Services Coordinator (ASC)	Scott Kirchner, CHMM
CDM Data Processor	Melinda Olsen

Resumes of the key CDM personnel are presented in Appendix A.

2.2 Responsibility

The CDM PM, Mr. Kershu Tan, P.E. is responsible for coordinating the work effort with the USACE PM, Mr. Eric Charlier, P.E. and with the EPA RPM, Mr. Ronald Naman. He is directly responsible for the technical content, schedule adherence, subcontract management, and financial management of the work assignment.

Mr. Tan will be assisted by Ms. Maria Watt, P.E., the TM, in implementing and coordinating the field investigation activities. She will work closely with the CDM PM and the FTL on the execution of the field activities.

The FTL is directly responsible for the coordination and execution of all field activities outlined in this FSP. It is the FTL responsibility to ensure that all field tasks are conducted in strict compliance with this FSP. All field personnel will report directly to the FTL on all matters relating to the field investigation. The FTL will also be responsible for sampling QC, ensuring that all field paperwork is completed correctly, that field quality control samples such as duplicates and blanks are collected, and that samples are stored, labeled, and shipped in accordance with the applicable requirements described in the SAP. In addition, the FTL will also be responsible for coordination with the USACE on-site Project Engineer regarding the use of USACE facilities, including the provided garage work area that CDM will utilize during the course of the field work. The FTL will also be responsible for the coordination of logistics and equipment storage issues with the on-site remedial action contractor, SES, through the USACE on-site Project Engineer. These issues will include the use of the SES existing on-site decontamination area for heavy equipment decontamination, use of the elevated asphalt pad fenced area next to Wheat Road for equipment and IDW storage, and the relocation, if necessary, of the crane mats that are currently set-up in the OU3 area providing access across the stream.

The CDM ASC, who will report to the TM, will ensure that the analytical laboratory performs analyses as described in the QAPP. He is responsible for coordinating with the CDM subcontract laboratory, scheduling samples and analyses through the laboratory, providing project staff with required sampling documentation forms, coordinating any required performance evaluation samples, overseeing contract compliance screening, tracking the data packages through the validation process, and providing the sampling results to the CDM TM. The CDM ASC will be responsible for all data management aspects of the project, including the development of the Automated Data Review (ADR) library that will be used for this sampling, the review and oversight of ADR electronic data deliverables (EDD) from the laboratory, and the management, storage, and upload of the data to USACE's Environmental Data Management System (EDMS). ADR and EDMS aspects of the project are discussed further in the QAPP. The ASC will communicate with project personnel regarding quality problems identified during these activities and will report any analytical data issues to USACE. Regarding the procurement of subcontractor laboratory services for non-routine analytical services analysis, the ASC will provide assistance to the project staff as needed.

The CHSO is responsible for the review of the existing site-specific Health and Safety Plan that governs the field activities outlined in this FSP. For this project, CDM has developed an Activity Hazard Analysis (AHA) to provide health and safety guidelines for the specific tasks to be performed, in lieu of a full Health and Safety Plan (HASP). The AHA (Appendix B) will be used in conjunction with the existing site-specific HASP that is in place for the OU1 and OU2 operations, which was developed by the on-site remedial action contractor SES.

The SHSO is responsible for ensuring that the protocols specified in the CDM AHA and SES HASP are followed during the field activities. The SHSO will also ensure that copies of the AHA, HASP, and the CDM Health and Safety Manual are maintained at the Site at all times, and that the field personnel have read and signed off. The SHSO is responsible for the upgrading or downgrading of the level of personal protection in accordance with the AHA and HASP, based on existing site conditions. The SHSO will also be responsible for daily tailgate safety meetings. If any questions or issues arise during field activities that cannot be addressed, the SHSO will contact the CHSO for direction and resolution.

The QAC is responsible for quality assurance audits (technical system audits) and correction of any noncompliance discovered. The QAC is also responsible for an internal system audit of project files, if necessary. Procedures for audits are provided in the Quality Assurance Project Plan (QAPP). The QAC is also responsible for participation in field planning meetings, QA review and approval of final reports or interim measurement reports, and QA review of procurement documents and the project work plan.

All sample analyses will be performed by an analytical laboratory under subcontract to CDM. The analytical laboratory will be certified by both the New Jersey State Department of Environmental Protection (NJDEP) and USACE for the parameters to be analyzed. CDM will validate the analytical data, using the Automated Data Review (ADR) software. All validation activities will be performed according to the QAPP.

2.3 Subcontractors

The services of the following subcontractors have been procured for this project.

- GEOD Corporation - A New Jersey licensed surveyor to locate sample points and survey streambed elevations in the Blackwater Branch
- Uni-Tech Drilling Co., Inc. - A New Jersey-licensed direct-push technology/drilling subcontractor to provide drilling services for collection of sediment samples
- Mitkem Corporation - An off site USACE and NJDEP certified laboratory subcontractor to perform the total arsenic, Toxicity Characteristic Leaching Procedure (TCLP) arsenic, and grain-size analyses

All subcontractor procurement packages are subject to CDM's technical and quality assurance reviews.

Section 3
Project Scope and Objectives

The overall objective of this field investigation is to further delineate the shallow (top ten feet) arsenic contamination within the floodplain area located along the Blackwater Branch. Sediment sampling will be performed to further delineate the lateral and vertical extent of arsenic contamination in the Blackwater Branch. The goal of the investigation is to provide USACE with further understanding of the different soil strata and contamination levels in this area to determine which portions of the OU3 contaminated materials can be excavated and treated by the on-site OU1 soil washing system. These additional investigations may also provide information to evaluate the effectiveness of the ongoing OU2 groundwater treatment remedy, which has been in operation since 2000.

In order to ensure complete delineation on an expedited basis of the shallow sediment contamination adjacent to Blackwater Branch, the field investigation consists of a base scope of work with the added flexibility of performing an additional optional scope of work. Based on the results of the base scope of work sampling, USACE may direct CDM to perform additional optional field investigation (Option 1) to further delineate the extent of the contamination. Arsenic samples collected as part of the base work will be analyzed with a two-day turnaround time to allow sufficient time prior to equipment demobilization to determine whether the optional work is required.

3.1 Task Description

The following is a discussion of the task objectives for the base work and Option 1.

3.1.1 Base Scope of Work

To accomplish the task objectives, the following activities will be performed in the field, as part of the base contract work:

- Mobilization/Demobilization
- Surveying
- Site Clearing
- Soil Boring Installation/Sample Collection

3.1.1.1 Mobilization/Demobilization

Mobilization will consist of the delivery to the Site of the necessary equipment, materials, and supplies to complete the work. EPA will be responsible for obtaining all necessary access agreements for the Site. This includes all agreements necessary to perform the work described in the SAP. CDM will notify the USACE at least three working days prior to field mobilization, to allow sufficient time for USACE to notify the appropriate property owners.

Demobilization will consist of the removal from the Site of all equipment, materials, and supplies after completion of the work, except for the IDW, which will be transferred to SES.

CDM will be responsible for the on-site containerization and transport of the investigation-derived waste (IDW) to the previously agreed upon fenced IDW staging area or the USACE provided CDM work area (garage), while USACE will be responsible for coordinating with SES for the transfer and removal of IDW. Procedures for handling the IDW are presented in Section 7.

3.1.1.2 Surveying

The primary objective of the base surveying work is to:

- Establish the location and elevation of the points of subsurface investigation (i.e., borings)
- Establish streambed elevations of the Blackwater Branch along ten transects

Prior to initiating the soil investigation, surveying will be performed to stake out the 57 sampling locations that are presented in Figure 3-1. These soil boring locations were selected by the USACE after review of previous historical sampling results, taking into account both impacted and clean sample results and locations. Survey data collected during this task will be compared to the existing site survey file available from previous investigations to determine the accuracy of the existing survey file.

In addition, surveying will be performed to collect streambed elevation data of the Blackwater Branch along ten transects, which are shown on Figure 3-1. The ten transects are located along the 1,700 foot section of the stream, east of the Mill Road bridge. Each transect will consist of a minimum of five survey points along each transect line, to collect data at each bank of the stream (top and bottom of each bank), as well as in the center of the stream. The exact number of survey points for each transect will be discussed with USACE and finalized prior to performing the survey. Location and elevation data will be collected at each point, and provided to USACE.

After the base scope of work has been performed, surveying services may be required again to locate additional "step-out" boring locations, as part of the Option 1 work discussed in Section 3.1.2.

3.1.1.3 Site Clearing

It is anticipated that some clearing may be needed to access soil boring locations. After the boring locations have been marked out, CDM's subcontract driller will perform site clearing as necessary to provide access to the boring locations for their drilling equipment and the field personnel.

In addition to site clearing, CDM's subcontract driller will construct an on-site decontamination pad for their drilling equipment and provide decontamination water as necessary. The decontamination water will be collected and drummed within the IDW staging area.

3.1.1.4 Soil Boring Installation and Sample Collection

The base scope of work consists of 57 soil borings, at the locations shown in Figure 3-1. The borings are identified as EIB-121 through EIB-177. Forty-nine of the 57 soil borings (EIB-121 through EIB-169) are in new locations not previously investigated, while 8 borings (EIB-170 through EIB-177) are located to resample points previously investigated by Malcolm Pirnie.

Each of the 49 new boring locations, EIB-121 through EIB-169, will be advanced to 10 feet below ground surface (bgs). For each of these borings, 5 composite soil samples will be collected, in approximate 2-foot intervals. It is expected that the borings will contain an organic soil layer in the top 4 feet bgs, followed by a sand layer for the remaining depth of the boring. In order to avoid any sample interval containing material from both the organic soil layer and the sand layer, the following sampling approach will be utilized.

The CDM project geologist will document all lithologic changes and correlate those changes with the following sample collection protocol and sample intervals. The first sample will be taken at 0 - 2 feet bgs within the organic soil layer. The second sample will be collected across the remaining organic soil layer from 2 feet bgs to the top of the sand layer, which is expected to be 1-2 feet thick (3 to 4 feet bgs). For the remaining depth of the boring, 3 samples will be collected in approximate 2 foot intervals, starting from the top of the sand layer. The final sample interval will be thicker or thinner, as necessary, to ensure that the final sample interval ends at 10 feet bgs.

If the organic soil layer is found to be less than 2 feet thick in any boring, then the first sample interval at that location will be adjusted accordingly such that the sample encompasses the organic layer only. In this case, the remaining 4 samples within the boring will be collected in approximate 2-foot intervals, with the final sample interval adjusted as necessary to end at 10 feet bgs.

The other eight boring locations, EIB-170 through EIB-177, are located to resample points previously investigated. The sampling within these borings targets the same intervals that were previously sampled. This sampling approach for borings EIB-170 through EIB-177 would provide data that is readily comparable to the previously collected results. However, the current site-specific lithology may require changes to the sampling approach for these borings. The USACE project geologist will be available during the sampling of these borings, and may adjust the sample intervals, based upon the observed lithology. Otherwise, these borings will be sampled according to the following table:

Soil Boring Number	Previous Sample Location	Boring Depth	Sample Interval
EIB-170	BB-SED5	4.5 feet	0 - 36 inches
			36 - 48 inches
			48 - 54 inches
EIB-171	BB-SED7	5 feet	0 - 54 inches
			54 - 60 inches
EIB-172	BB-SED9	5 feet	0 - 3 feet
			3 - 5 feet
EIB-173	SB-37	4 feet	0 - 2 feet
			2 - 4 feet
EIB-174	SB-44	6 feet	0 - 2 feet
			2 - 4 feet
			4 - 6 feet
EIB-175	SB-45	4 feet	0 - 2 feet
			2 - 4 feet
EIB-176	SB-46	6 feet	0 - 2 feet
			2 - 4 feet
			4 - 6 feet
EIB-177	FB-19	6 feet	0 - 2 feet
			2 - 4 feet
			4 - 6 feet

Based on these sampling intervals for the base scope of work, a total of 265 environmental samples will be collected, 245 samples for borings EIB-121 through EIB-169, and 20 samples for borings EIB-170 through 177. In addition, field quality control (QC) samples will be collected as environmental duplicates at a rate of 5%, resulting in 14 duplicate samples. Also, one equipment rinsate blank sample will be performed daily during the sampling event.

All of this base scope of work samples will be analyzed for total arsenic, according to EPA analytical method SW-846 6010B. These samples will be analyzed on an expedited 2-day turnaround time, in order to obtain the majority of the sample results from the laboratory while the field team and driller are still mobilized in the field. The arsenic results will be compared to the EPA cleanup criterion of 20 mg/kg, which is also the NJ Residential Direct Contact Soil Cleanup Criteria (NJRDCSCC) for arsenic as specified in the NJ Administrative Code (NJAC 7:26D).

In addition to the arsenic analyses, 10% of the sample intervals (27 samples) will be analyzed for grain size according to the American Society of Testing and Materials (ASTM) D422-63, and five sample intervals will be analyzed for TCLP, arsenic only analysis, according to EPA method SW-846 1311/6010B.

In order to ensure that the grain-size and TCLP analyses are performed within the contaminated zone, these specific sample intervals will be selected by USACE after receipt of the quick turnaround time arsenic data. CDM will containerize, label, and store (on-site) the remaining sediments from each sample interval, pending USACE selection of the appropriate grain-size and TCLP intervals. In order to accommodate on-site storage of this material, USACE has waived the refrigeration preservation requirement for the five TCLP arsenic samples. Once the sample intervals have been

selected for grain-size and TCLP analysis, the material will be sent to the laboratory for standard turnaround time analysis. Sediment from the remaining sample intervals not selected for these analyses will be handled as sediment IDW, as described in Section 7.

Also, in accordance with Section 3.2 of the QAPP, samples will also be analyzed for additional laboratory QC parameters such as matrix spike (MS)/matrix duplicate (MD) at a rate of 5% of the total soil samples. No additional soil volume will be required, but the MS/MD analyses will be identified as additional sample parameters on the sample chain-of-custody (COC) prior to sample shipment. A summary of the sample parameters and quality control frequencies is provided in Table 4-1.

Since all sediments within each boring will be containerized for possible analysis, each borehole will be backfilled with a grout slurry of neat cement across the entire depth of the boring. At a minimum, the backfill and grouting of completed boreholes will be completed at the end of each work day.

3.1.2 Option 1

Based on field conditions encountered and the analytical data obtained during the base scope of work portion of the field investigation, optional "step-out" soil borings and samples may also be collected. Option 1, if exercised by USACE, includes up to 20 additional soil borings and 100 additional arsenic soil sample analyses. Option 1 characterization is similar to the base contract but does not include grain-size geotechnical or TCLP disposal analyses, and calls for the standard laboratory turnaround time as opposed to the 2-day turnaround time utilized for the base scope of work samples. A summary of the sample parameters and quality control frequencies is provided in Table 4-1.

Since Option 1 does not include a separate drilling mobilization, the decision to perform these additional borings will be made prior to the completion of the base scope of work sampling and drilling demobilization. CDM will provide the preliminary base scope of work sample results to USACE as the results become available from the laboratory. Note that even with the 2-day turnaround time, not all of the base scope of work sample results will be received from the laboratory before the end of the base field work. Therefore, as the base scope of work sampling nears completion, USACE will make the decision to exercise Option 1 using as much data as is available at that time.

If Option 1 is exercised, USACE will provide CDM with up to 20 additional proposed boring locations. Optional work borings will continue the numbering and labeling scheme utilized for the base scope of work borings, beginning with EIB-178. Unless otherwise directed, each additional soil boring will be installed to a depth of 10 feet bgs, with 5 samples collected across the boring interval, as described in Section 3.1.1.4. In order to avoid delays, the Option 1 borings will be located in the field as accurately as possible without the use of a surveyor. At the completion of all Option 1 soil borings, the surveyor will return to the Site and collect the location and elevation data for the additional borings, for addition to the base map.

3.2 Applicable Regulations/Standards

All field activities, including surveying, will be performed by personnel who have received Occupational Safety and Health Administration (OSHA) 40 Hour Health and Safety Training, according to the Code of Federal Regulations (29 CFR 1910.120). All work will comply with the requirements of Engineering Manual EM 385-1-1 (USACE Safety and Health Requirements Manual), with particular attention to Sections 1, 5, 11E, and 16M, and the particular hazard of dead falling trees.

All surveying will be performed by a New Jersey State licensed surveyor and all survey data will be collected relative to the New Jersey State plane coordinate system.

All drilling will be performed by a New Jersey State licensed driller, in accordance with the NJDEP Field Sampling Procedures Manual, May 1992, where applicable. Soil classification by the project geologist will be performed in accordance with the Unified Soil Classification System.

3.3 Schedule

All field and office work will be completed for this contract within 120 calendar days of the notice to proceed (NTP). The total period of performance for this contract is 190 calendar days. The schedule is subject to adjustment by USACE, in writing, for delays on the part of USACE, and for any unforeseen conditions beyond the control of CDM, such as poor weather.

The following is a schedule of the project milestones for this work:

- Submit the draft SAP (FSP and QAPP) and the AHA (in lieu of a full HASP) within 20 calendar days of NTP
- Submit the ADR library for USACE approval prior to performance of drilling/sampling
- Complete the field activities within 90 calendar days of NTP
    - Optional work will be awarded within 20 days of the start of drilling activities and will not impact the total period of performance
- Submit the draft report summarizing the results of the investigation within 160 calendar days of NTP
- Submit the final report within 15 calendar days of receipt of Government comments (the Government will provide comments within 15 calendar days of receipt of the draft report)

It is anticipated that the base field work will require approximately 5 days of site clearing activities and 10 days of drilling and sampling. Option 1, if exercised, will require up to 5 additional days of field work.

Section 4
Field Activities and Procedures

This section discusses the field activities and procedures that will be utilized to perform the work. The field activities have been divided into the following tasks, which are discussed further by section herein:

- Mobilization
- Topographic Survey
- Site Clearing
- Drilling and Sampling
- Decontamination
- Site Restoration and Demobilization

The procedures described herein apply to both the base and optional work portions of the contract, unless otherwise specified.

4.1 Mobilization

4.1.1 Field Planning Meeting

Prior to the mobilization for field activities, a field planning meeting will be conducted by the CDM PM and attended by the field staff and the CDM QAC. A field planning meeting may be held in the field instead of the office if this is more convenient for the personnel involved. In this case, the PM will forward the agenda to the QAC for review before the meeting. The meeting will briefly discuss and clarify:

- Objectives of the field work
- Equipment and training needs
- Field operating procedures, schedules of events, and individual assignments
- Required QC measures
- Documents governing field work that must be on site

A written agenda, reviewed by the QAC, will be distributed and an attendance list signed. Copies of these documents will be maintained in the project files by the CDM PM. Additional meetings will be held when the documents governing field work require it, when the scope of the assignment changes significantly, when the field staff changes, or if the QAC determines that maintenance of QC protocol requirements merits another meeting.

Additionally, before initiating the sample collection activities, the following preparatory activities must be completed:

- Procure subcontractor services prior to the initiation of field activities.
- Before arriving on site, the field team will review and discuss elements of this FSP and the existing site HASP, prepared for the ongoing OU1 work by SES. Personal protective equipment and health and safety guidelines are specified

for each activity in the CDM developed AHA (Appendix C) which will supplement the existing site HASP.

- Ensure that all sample analyses are scheduled through the CDM subcontracted laboratory.
- Obtain required sample containers and preservatives. Additional sample bottles will be taken into the field to allow for breakage.
- The identification number, maintenance and calibration dates (by the supplier or CDM FTL), and the person(s) assigned to perform field calibrations and checks for each field instrument used will be documented in the field logbook.
- Obtain demonstrated analyte-free water for equipment rinsate blank preparation and other field operations.
- Locate the Federal Express, or other reliable overnight delivery service nearest the site and note its hours of operation. Determine whether this office location will provide sample pick-up services.
- Obtain all necessary field sampling equipment.
- Arrange for containerization of disposable material and clothing.
- Obtain all personal protective and field instrument decontamination equipment.
- Confirm that access permission has been obtained for all field activities.
- Coordinate with USACE and EPA for the use of the existing site facilities for the duration of the field work.
- Notify local police and hospital of where, when, and what activities will be conducted.
- Arrange for the drilling subcontractor to construct a decontamination pad for heavy equipment.

4.1.2 Field Mobilization

Upon receipt of NTP, a site visit will be performed to inspect the site and determine all general and local conditions that may affect the execution of the field work. The site visit will be coordinated through Mr. Eric Charlier of the USACE Philadelphia District's Design Management Section at (215) 656-6668.

CDM will notify USACE at least three working days prior to field mobilization, to allow sufficient time for USACE to notify the appropriate property owners. Prior to initiating intrusive activities, CDM will establish work zones to ensure the health and safety of the field team members and to prevent the off-site migration of contaminants as a result of field activities. CDM will establish the following work zones:

Exclusion Zone: The exclusion zone is defined as the area where intrusive activities are conducted. The zone will be clearly flagged and delineated. No personnel will be allowed into the exclusion zone without the proper personal protective equipment, site training, and medical authorization.

Contaminant Reduction Zone: A contaminant reduction zone will be established between the exclusion and support zones. Decontamination of personnel and equipment will occur in this area.

Support Zone: The support zone will be established in an uncontaminated area of the site. Sanitary facilities, safety and support equipment, and the field trailer will be located in this area. Site operations and site access will be controlled from this work zone.

CDM will have an on-site pre-work safety meeting with the drilling and surveying subcontractors during initial field mobilization. Since the surveying and drilling subcontractors will have different site work schedules, a separate meeting will be held with each subcontractor. The USACE on-site project engineer will be invited to attend each of these safety meetings.

In addition, as part of the field mobilization, CDM's drilling subcontractor will construct an on-site decontamination pad. The drilling subcontractor will be responsible for providing decontamination water to be used at this pad. Drilling equipment shall be thoroughly steam-cleaned at the onsite decontamination pad between each drilling location.

The liner on which decontamination occurs shall be made of 30-mil. polyethylene. Hay bales or timber shall be placed over the bottom 30-mil. liner and used to construct the curb. Another 30-mil. liner will be placed over the curb and previous liner. A sump pump shall be placed in a corner. The pad will be sloped so that the pump will collect the decontamination fluids. The decontamination pad will be inspected at least once a week during active use and repairs will be made as necessary. Decontamination fluids will be transferred into a 55-gallon drum and fines will be allowed to settle.

All decontamination water will be collected, drummed, and stored within the previously agreed upon fenced IDW staging area abutting the OU3 wetland area.

4.2 Topographic Survey

The field work will consist of the following surveyor tasks:

- Establish the location and elevation of the points of subsurface investigation (i.e., borings)
- Establish the streambed elevations of the Blackwater Branch along ten evenly spaced transects

The surveying will be performed relative to the New Jersey State plane coordinate system, North Atlantic Datum (NAD) 83 and North Atlantic Vertical Datum (NAVD)

88, by a licensed surveyor in the State of New Jersey.

Datums

HORIZONTAL- NAD 83 STATE OF NEW JERSEY
VERTICAL- NAVD 88

Site survey control and baseline will be established if necessary by either conventional survey methods with the use of total station equipment or by Differential Global Positioning System (DGPS) techniques. These control points will be marked with permanent type marks and will be intervisible. Control descriptions with swing ties will be provided for the established control points with x, y and z positions provided in the appropriate datum's. There are several control points already located at the site. Two new intervisible points will be established, if the existing control points are not sufficient to perform the work.

After the boring locations are staked and labeled, USACE will review the potential boring locations prior to the initiation of drilling. Boring locations will be adjusted based on the presence of utilities and other field conditions. The USACE Geotechnical Section point of contact, Mr. Mark Chamberlain - (215) 656-6671, will be contacted prior to commencement of surveying activity to ensure the markings are established.

Survey information (coordinates and elevations of all locations) will be provided to the USACE in electronic format. In addition, a scaled map will be prepared using the base map AutoCAD file obtained from USACE, presenting the locations of all the new soil boring locations and the stream bed transects.

In the event that Option 1 is exercised and additional borings are performed at locations directed by USACE, an additional surveyor mobilization will be performed at the completion of the drilling. The surveyor will return to the site after all soil borings have been completed in order to collect the location and elevation of each of the optional work borings.

4.3 Site Clearing

After the boring locations have been marked out, CDM's subcontract driller will perform site clearing as necessary to provide access to the boring locations for their drilling equipment and the field personnel. Conventional drill rigs as well as amphibious drill rigs may not be able to maneuver in the OU3 area; therefore, geoprobing® or hand methods (powered or manual) may be utilized. The level of the site clearing effort will be commensurate with the drilling equipment to be utilized.

Debris and cuttings resulting from the site clearing will not be removed from the site and instead will be left in-place.

4.4 Drilling and Sampling

Subsurface soil samples will be collected from 57 base work boring locations and up to 20 optional work boring locations. Refer to Section 3.1.1.4 and 3.1.2 for a description of

the boring locations and sampling intervals. The Geoprobe® or equivalent direct push sampling technique will be used. In general, CDM's Technical Standard Operating Procedure (TSOP) 3-1, *Geoprobe® Sampling*, found in Appendix B, will be used as a guidance for conducting direct push sampling. However, the specific standard operation procedure (SOP) used for the direct push technology will be supplied by the drilling subcontractor selected to perform the soil borings. This SOP will be checked against the specifications required by TSOP 3-1, this FSP, and the drilling subcontract statement of work prior to approval.

4.4.1 Preparatory Activities

Prior to initiating any field activities, the field team will review and discuss, in detail, the existing Site HASP, the AHA (Appendix C), and any appropriate SAP sections. All monitoring and protective equipment will be thoroughly checked at this time.

CDM will notify the USACE's point-of-contact in Geotechnical Section, Mr. Mark Chamberlain at (215) 656-6671, at least three working days prior to beginning any drilling.

In addition, at least three working days prior to commencing the soil drilling, the New Jersey One Call system will be contacted to determine and mark the utilities location. CDM will also coordinate with USACE to check with SES on existing site utilities.

Additional preparatory activities which apply to the soil boring sampling activity are as follows:

- A drilling subcontractor will be procured to perform direct-push drilling at the chosen soil boring locations.
- Sampling locations will be established in the field by the subcontract surveyor, prior to mobilization of the direct-push technology subcontractor.
- All underground and overhead utilities and structures which may interfere with the progress of the work will be located by the subcontractor prior to commencement of subsurface drilling activities.
- Site clearing will be performed as necessary to facilitate maneuverability and positioning of drilling equipment at each of the boring locations. The site clearing will be performed by the drilling technology subcontractor, prior to the commencement of drilling. The level of the site clearing will be commensurate with the drilling equipment to be utilized at each soil boring location.

4.4.2 Field Equipment

The equipment required for the subsurface soil sampling with a Geoprobe® or an equivalent direct push technology are listed in TSOP 3-1. However, in addition to the equipment listed in TSOP 3-1, the following equipment will be required:

- Field table
- Polyethylene sheeting
- Utility knife
- Folding rule
- Munsell soil color chart
- Camera and film
- Paper towels

For each soil sampling interval, the following equipment will be required:

- Stainless steel bowl and trowel
- Sample labels
- Appropriate sample bottleware

4.4.3 Drilling Procedures

Drilling will be performed using a Geoprobe® rig or equivalent direct push approach, and will follow the general procedures outlined in TSOP 3-1, Section 5.1 (Geoprobe® Soil Sampling), found in Appendix B. Due to the wetland site conditions, conventional Geoprobe® drill rigs may not be able to access all boring locations, requiring other direct-push or hand drilling methods (powered or manual). A tripod mounted drilling system will likely be used at several locations.

All borings will be installed using a dual-tube system or equivalent approach, to protect the integrity of the sidewalls of the open borings and prevent material sloughing and cross-contamination within the boring from above intervals.

Soil samples will be collected from each boring as discussed in Section 3. At the completion of each boring, the void space within each boring will be backfilled with a grout slurry of neat cement up to ground surface, across the entire depth of the boring. Abandonment of completed soil borings will be performed within the same day of drilling.

The disposable plastic Geoprobe® liners that contact the soil will be collected and handled as disposable PPE. They will be bundled and taped together for IDW transfer to SES.

4.4.4 Soil Lithology and Boring Logs

Soil lithology will be recorded for each boring in accordance with the requirements of TSOP 3-5, *Lithologic Logging* (Appendix B), by the CDM project geologist. The following information will be included on the logs and in the records for each soil boring:

- Project, location, boring number or designation, geologist name, starting and ending dates and times, and ground surface survey data including location, elevation and the referenced datum (if known)

- Size and type of drilling equipment used to install the boring, including the outer casing
- Soil classification using the Unified Soil Classification System, percent of material recovered, and depth to water table
- Sample intervals and analytical parameters
- Total depth of bottom of hole

Upon the completion of the work, electronic boring logs will be prepared and submitted to USACE using Rockware's ™ Logplot software program. The boring logs will be provided to USACE within two weeks of completion of the work.

4.4.5 Soil Sampling Procedures

CDM will collect soil samples from the boring locations shown on Figure 3-1. Refer to Section 3 for the sampling intervals and parameters. Table 4-1 provides a summary of the sampling parameters, including the method, required sample jars, bottles, and containers, and the required preservatives.

The samples will be collected following TSOP 3-1, Section 5.1 for Geoprobe® Soil Sampling. The procedure involves collecting the desired sample interval from the Geoprobe® liner into a clean stainless steel mixing bowl, mixing the soil to homogenize the entire interval into a composite sample, and then filling the required number of sample jars for the total arsenic samples and quality control duplicate samples. The filled sample jars will then be cleaned off, labeled, and stored on ice in accordance with the TSOP. The sample names, labels, and custody requirements are discussed in Section 5. The sample packaging and shipping requirements are discussed in Section 6.

The remaining soil cuttings will then be containerized, labeled, and transported back to CDM's on-site work area (garage). These sediments will be stored at that location, without refrigeration, pending USACE selection of the appropriate grain-size and TCLP sample intervals. Upon receipt and review of the quick turnaround time arsenic data, USACE will select five sample intervals for TCLP arsenic analysis, and ten percent of the total sample intervals for grain-size analysis. These intervals will then be packed and shipped to the laboratory for standard turnaround time analysis. The remaining sample intervals will become sediment IDW, as discussed in Section 7.

4.4.6 Water Sampling Procedures

In addition to the soil samples discussed above, equipment rinsate samples will be collected daily, for total arsenic analysis.

For these daily equipment rinsate blanks, demonstrated analyte-free water will be poured into and over a complete set of sampling apparatus (stainless steel mixing bowl, spoons, etc.). The sampling apparatus will have already undergone full equipment decontamination, as discussed in Section 4.5. The water will then be poured from the bowl directly into the pre-preserved sample jars. As shown on Table 4-1, nitric acid will be used as the preservative for all aqueous samples that will be analyzed for arsenic.

4.5 Decontamination Procedures

Field decontamination will be performed on all personnel and equipment that enter the exclusion zone. Personnel decontamination procedures will be implemented to prevent worker exposure to site contaminants. Equipment decontamination procedures will be implemented to prevent cross-contamination of environmental samples and prevent off-site migration of contaminants as a result of site investigation activities.

For this task, decontamination will be required for:

- Drilling equipment and other large pieces of equipment
- Sampling apparatus such as mixing bowls and spoons
- Any non-disposable PPE

Drilling Equipment and Other Large Pieces of Equipment

An on-site equipment decontamination pad will be constructed prior to any intrusive field activities. The decontamination pad will be used to decontaminate the drilling equipment or other large pieces of equipment.

All drilling equipment that comes in contact with the soil will be brushed off and then steam cleaned before use, and after drilling each soil boring location. This includes drill rods, bits and augers, dredges, or any other large piece of equipment.

For the Geoprobe® sampling approach, a hollow metal sampling tube is advanced through the soil by direct-push drilling to collect the soil to be sampled. Prior to each direct push sample, a disposable plastic liner is inserted into the metal sampling tube. Since the soil sample is actually contacting the disposable liner and not the metal sampling tube, the metal sampling tube does not require steam cleaning in between each sample interval, and instead will only be field decontaminated in between uses according to the procedure below for sampling apparatus. However, the sampling tubes will be fully steam cleaned at the decontamination pad in between use at each new boring location, to avoid cross-contamination across the site. The disposable plastic Geoprobe® liners will be collected and bagged with the disposable PPE, and will be transferred to the on-site remediation contractor SES at the completion of the work.

Sampling Apparatus

For the smaller sampling apparatus, such as mixing bowls and spoons, decontamination stations will be established near each boring location. All sampling apparatus must be properly decontaminated prior to each use, including the first usage in the field, according to the following procedure:

a. Wash and scrub with low phosphate detergent
b. Tap water rinse from a municipial water treatment system (untreated potable water supply is not an acceptable substitution)
c. 10 percent nitric acid rinse, ultra pure grade (one percent solution will be used when carbon steel equipments, such as split-spoons, are used)
d. Demonstrated analyte-free water rinse

e. Air dry
f. Wrap in aluminum foil, shiny side out, for transport

While performing decontamination activities, phthalate-free gloves will be used to prevent inadvertent phthalate contamination of the sampling equipment.

At a minimum, the following equipment will be utilized for decontamination:

- Steam cleaner
- Power source (e.g., generator), if required
- Distilled/deionized water
- Demonstrated analyte-free water
- Potable water
- Polyethylene sheeting
- Utility knife
- Deep basins
- Brush
- Non-phosphate detergent (i.e. Alconox)
- 10 percent nitric acid (one percent when needed), ultra pure grade
- Aluminum foil
- Personal protective equipment
- Air monitoring equipment and calibration gas

Personal Protective Equipment (Non-Disposable)

All non-disposable PPE will also be decontaminated in accordance with the manufacturer requirements, or according to the following procedure:

- Non-residual detergent (Alconox™) and tap water rinse
- Respirator sanitizer (for respirator or self contained breathing apparatus (SCBA) face piece)
- Thorough rinse with potable water
- Air dry

Disposable PPE will be collected daily and stored within the IDW staging area.

4.6 Site Restoration and Demobilization

After site work is complete, the FTL and/or designated field staff will be responsible for the removal of all equipment from the Site, except for the generated IDW that will be left on-site for transfer by SES. The equipment decontamination pad will be removed and disposable items will be added to the IDW waste as necessary.

No other site restoration work is anticipated. Paving or concrete restoration is not anticipated. The site clearing cuttings will be left in place in the wetland area.

Section 5
Project Documentation

This section primarily refers to the documentation and recordkeeping requirements necessary for performance of the field work, including the sample collection, management, shipment, and tracking. It also includes a discussion of the required documentation to complete changes to the FSP.

5.1 Daily Quality Control Reports

Documentation for field activities will be submitted to USACE using daily quality control reports (DQCRs). The DQCRs will be completed and submitted to the USACE on-site project engineer, Mr. Steve Creighton, daily. The information recorded will include the date, weather, on-site personnel, a brief summary of the activities completed that day, and a description of any specific issues, problems, or changes. An example DQCR is included as Figure 5-1.

5.2 Field Logbook

All field work will be documented in the project site-specific field logbooks. Field logbooks will be maintained by the field team in accordance with CDM TSOP 4-1, *Field Logbook Content and Control* (Appendix B). The FTL is responsible for the maintenance and document control of the field logbooks.

Logbook modification requirements are also described in the TSOP. If required, a single strikeout will be used to make changes, with each modification initialed and dated. The correct information should be entered in close proximity to the erroneous entry.

5.3 Sample Tracking Log

As a supplement to the logbook, sample tracking sheets will be used to record sample specific information in a comprehensive, consistent, and convenient manner. An example sample tracking sheet is provided as Figure 5-2. Sample tracking sheets will serve as a log of the samples collected by the field team. Information recorded will include the name, date, time and matrix type of the samples, the requested analyses, and any QC or QA notations. Field duplicate samples will be entered onto the sample tracking log as a separate line entry, but will include notation to indicate which parent sample they duplicate.

5.4 Instrument Calibration Records

Refer to Section 5.2 of the QAPP for the documentation requirements for instrument calibration records. For this project, the only instrument requiring calibration will be the Multi-RAE portable air monitoring device, which will be used to conduct health and safety monitoring in accordance with the AHA (Appendix C) and the site-specific HASP.

5.5 Photographic Records

Photographic records will be maintained by the field team in accordance with CDM TSOP 4-2, *Photographic Documentation of Field Activities* (Appendix B). A photolog will be prepared for photographs of site activities, in accordance with the TSOP. At a minimum, a few photographs will be collected of each significant portion of the work for documentation of the equipment and approach utilized. The records will be maintained with the logbook in the project file.

5.6 Sample Numbering System

An alpha-numeric coding system will be used to uniquely identify each sample collected during the field investigation phase of the project. This coding system will provide a tracking record to allow retrieval of information about a particular sample and ensure that each sample is uniquely identified.

Sample Identification for the Soil Boring Samples

For both the base and optional work soil borings, each sample will be numbered with the boring location (EIB-121 through EIB-177) followed by a letter at the end to indicate the corresponding sample interval.

For example, the sample identifier for the first sample in soil boring EIB-121 will be EIB-121A, which will correspond to the first sample interval (0 to 2 feet bgs) in the EIB-121 boring location. The following sample will be identified as EIB-121B, with the suffix letter advancing down the alphabet for each subsequent sample interval. The corresponding depth of the sample collection will be noted in the field logbook, and on the sample tracking sheet/log.

In addition to the total arsenic analysis for all soil boring samples, 10% of the samples will be analyzed for grain size, and five samples will be analyzed for TCLP arsenic only analysis. The same sample nomenclature will be used for these samples, with the appropriate sample analyses/parameters requested as necessary.

Field Duplicate Samples

For the soil samples, environmental duplicate QC samples will be collected at a rate of 5% for arsenic analysis only. Each duplicate sample will be submitted "blind" to the laboratory by using a different sample number than the associated environmental sample. The actual collection date and time will be recorded for both the environmental sample and its duplicate.

To maintain consistent sample nomenclature, field duplicates will be labeled with a false boring location, starting with EIB-501, with the boring location number increasing for each subsequent field duplicate collected. The suffix letter that represents the sample interval will be the same as the corresponding parent sample. For example, if the first environmental duplicate sample is collected from the EIB-122D sample interval, the duplicate sample would be labeled EIB-501D. If the next duplicate sample is collected from EIB-125B, the duplicate would be labeled EIB-502B. Considering that there are 265 base work samples and up to 100 additional optional

work samples, and that duplicates will be collected at a rate of 5%, it is anticipated that there will between 14 and 19 duplicate samples.

Equipment Rinsate Samples
Equipment rinsate samples will be numbered by using the prefix "ER" in front of the date as follows: ER120204 for December 2, 2004.

Since there are no volatile organics analyses, trip blanks will not be required.

5.7 Sample Labels

Sample bottles will be pre-labeled prior to sample collection. All pertinent sample information will be noted on the label including the sample identification number, date and time the sample was collected, the type of sample, initials of person collecting the sample, preservation used and the analysis for which that sample is being submitted. Labels will be filled out with indelible ink and protected with clear tape.

5.8 Sample Custody

5.8.1 Chain-of-Custody Records

The primary objective of sample custody is to create an accurate record that can be used to trace the possession and handling of samples so that their quality and integrity can be documented and maintained from collection until completion of all required analyses. Adequate sample custody will be achieved by means of the COC record initially completed by the sampler, and thereafter signed by each individual who accepts custody of the sample. A sample will be considered to be in someone's custody under the following conditions:

- The sample is in physical possession.
- The sample is in view.
- The sample is locked, secured in a locked container, or otherwise sealed so that tampering will be evident.
- The sample is kept in a secured area, restricted to authorized personnel only.

Sample control and COC in the field and during transport to the laboratory will be conducted in general conformance with the procedures described in the following subsections.

Copies of the sample COCs, in addition to laboratory check-in forms, will be provided to the USACE project chemist, Erika McCormick, on a daily basis.

5.8.2 Field Custody Procedures

Field custody of samples will be maintained as specified in CDM TSOP 1-2, *Sample Custody* (Appendix B). The following field custody procedures will be followed:

- As few persons as necessary will handle samples.

- Sample bottles will be purchased directly from the manufacturer by CDM, or obtained new or precleaned from the laboratory performing the analysis.
- The person collecting the sample will be responsible for completing the COC record and for the care and custody of collected samples until they are transferred to another person under COC rules.
- CDM's FTL will oversee field custody procedures during the fieldwork, and in the event of noncompliance, will determine if corrective action is required.

5.8.3 Sample Shipment Custody Procedures

The coolers in which the samples are shipped will be accompanied by the COC record identifying their contents. The original record and laboratory copy will accompany the shipment (sealed inside the shipping container). The third copy will be distributed, as appropriate, to the CDM TM.

Sample shipment will be in accordance with TSOP 2-1, *Packaging and Shipping Environmental Samples* (Appendix B). Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier (i.e., Federal Express), and other pertinent information will be entered in the remarks section of the COC record.

5.8.4 Transfer of Custody

When samples are transferred, the individuals relinquishing and receiving the samples will sign the COC record and document the date and time of transfer. The person who collects the sample will sign the form in the first signature space. If the samples are shipped via commercial carriers, the COC records will be sealed inside the sample container before delivery, and the custody signature will be from the person who receives the samples at its final destination (i.e., laboratory sample custodian). Each person taking custody will evaluate the integrity of the shipping container seal and note any observations on the COC record. Project documentation of complete sample custody from field to laboratory will be verified during review of the analytical data package.

5.8.5 Laboratory Custody Procedures and Documentation

Laboratory custody procedures are provided in the QAPP section of this SAP.

5.9 Deviations to SAP/Field Change Request Form

In the event that anticipated conditions are different from those encountered once the field work is under way, it may be necessary to implement a deviation from the approved SAP.

Minor deviations will be communicated verbally to the USACE PM and EPA RPM, and documented on the DQCRs. Significant changes will be made in writing and will be sent to the USACE and EPA for approval prior to their implementation.

All field changes will be documented on a Field Change Request Form (FCR), which will be signed by the FTL and the CDM PM. A copy of the FCR Form is included as Figure 5-3, and will be kept on-site throughout the duration of the field work. Copies of completed FCR forms will be distributed to the authorizing parties, the field staff, and the CDM QAC in order to keep all staff informed of the change and to allow oversight of any changes.

Additionally, resulting project reports will include a QA section detailing deviations.

5.10 Non-conformance/Corrective Action

During the course of the field work, corrective action may be required for major problems resulting in a non-conformance with this FSP. Section 5.5 of the QAPP discusses the corrective actions to be utilized to correct these problems using CDM's established QA/QC protocols.

5.11 Project Files

Documentation related to QC and execution of the field activities will be available upon request for review by USACE personnel. This will include field logbooks, COCs, the completed field forms, and subcontractor records. This FSP will be available to all CDM field personnel during sampling operations for use as a reference.

A copy of all field documentation will be maintained in the project file in CDM's Edison, NJ office. The files will be maintained according to USACE requirements and CDM's *QA Manual*, as modified by the contract specific QIP.

5.12 Project Deliverables

The major project deliverables are the draft and final reports. Activities required to support report preparation include data reduction and evaluations; data management and review, data reporting; GIS/AutoCAD work and figure preparation; electronic boring log preparation; data contouring; and assessment of data quality.

The report will be a data summary report to support USACE. The report will aid in the delineation of the vertical and horizontal extent of the contamination. Following the completion of work and the receipt of analytical data for the sampling event, CDM will prepare and submit four copies of a draft report. The report will include a summary of field activities, field notes, pictures of the sampling event, data validation (using ADR software) narrative, EDMS Tables 1 through 4 and summary tables of validated analytical results. Sampling locations, depths, and analytical results will be included in the report.

A table will be provided showing the horizontal and vertical coordinates of the boring locations. The surveying subcontractor will measure elevations within the OU3 floodplain area to verify the elevations and contours on the existing site base map. CDM will summarize the deviation in elevations from those presented in the existing base map. If the field verification of elevations indicates that the site base map contours are accurate, then the Blackwater Branch elevations will be blended with the

old topography (existing base map) of the surrounding areas. The site map will also present the boring locations (old and new) and the concentrations exceeding the regulatory criteria.

The report will include the methods and a summary of the results of the investigation, and include maps depicting all survey stations, and soil boring locations. Data will be provided in hard copy and as an electronic file (ADR EDDs, ADR output files) and in EDMS, Access database. A summary table of all analytical results will be presented with the appropriate criteria. Data results exceeding the criteria will be shaded and highlighted.

Iso-concentration maps will be generated for the floodplain zone with the data from this round of sampling and previous data. Five contour maps will be prepared. The draft report will be submitted to USACE and EPA for review and comment. If USACE requests additional work under the optional work items, additional effort will be required to incorporate and evaluate the additional data in the draft report.

Section 6
Sample Packaging and Shipping Requirements

Samples will be packaged and shipped as environmental samples following the procedures stated in CDM TSOP 2-1, *Packaging and Shipping of Environmental Samples* included in Appendix B, specifically Sections 1.4 for the soil samples and Section 5 for the aqueous samples preserved with nitric acid.

Coolers containing field samples will be shipped to the following address:

Mitkem Corporation
175 Metro Center Boulevard
Warwick, Rhode Island 02886-1755
Phone: (401) 732-3400
Fax: (401) 732-3499

All samples will be shipped each day that they are collected via Federal Express using priority overnight delivery. Samples will not be shipped on Fridays without prior telephone notification made to the laboratory. In the event samples are shipped on Friday, the block marked "SATURDAY DELIVERY" will be checked on the shipping bill.

It is expected that samples will be shipped daily for the duration of the drilling and sampling portion of the field work, which is estimated as 10 working days for the base work sampling and up to 5 working days for the optional work.

Copies of the sample COCs, in addition to laboratory check-in forms, will be provided to the USACE project chemist, Erika McCormick (Erika.f.mccormick@usace.army.mil), on a daily basis.

Section 7
Investigation-Derived Waste

For this project, IDW will consist of the following waste streams:

- Decontamination water
- Disposable PPE (e.g., used Tyvek coveralls, gloves, boot covers)
- Disposable plastic Geoprobe® liners
- Sediments and cuttings not sent for laboratory analysis

IDW staging and storage areas have already been identified, and will be set up during the mobilization phase of the field activities. These areas were selected considering site logistics (the location of the area with respect to the points of waste generation), safety and stability (the location will be stable and will not impact the safety of workers), and interference with on-going site activities.

IDW will be transported to the previously agreed upon fenced IDW staging area abutting the OU3 wetland area or the USACE provided CDM on-site work area (garage), depending on the type of waste.

Decontamination water, sample liners, and PPE will be transported to the previously agreed upon fenced IDW staging area abutting the OU3 wetland area. The decontamination water will be collected in standard 55 gallon drums. The disposable PPE will be collected in contractor grade-trash bags. The disposable Geoprobe® sample liners will be collected and taped together into manageable bundles. Drums in the storage area will be labeled, numbered, and a log of their contents will be maintained on site.

Remaining sediments and cuttings which are not sent for laboratory analysis will become sediment IDW upon the completion of the work. These will be transported and to the USACE provided CDM on-site work area (garage).

At the completion of the field work, CDM will notify the USACE on-site project engineer of the approximate volume of IDW at both of these IDW staging areas. USACE will be responsible for coordinating with SES for the transfer and removal of this IDW.

Section 8
References

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Section 9
Acronyms

ADR	Automated Data Review
AHA	Activity Hazard Analysis
ASC	Analytical Services Coordinator
ADR	Automated Data Review
ASTM	American Society of Testing and Materials·
bgs	Below Ground Surface
CDM	CDM Federal Programs Corporation
CHMM	Certified Hazardous Materials Manager .
CHSO	Corporate Health and Safety Officer
COC	Chain-of-Custody
CFR	Code of Federal Regulations
DGPS	Differential Global Positioning System
DQCR	Daily Quality Control Report
EDD	Electronic Data Deliverable
EDMS	Environmental Data Management System
EPA	United States Environmental Protection Agency
FCR	Field Change Request
FSP	Field Sampling Plan
FTL	Field Team Leader
HASP	Health and Safety Plan
IDW	Investigation-Derived Waste
MS	Matrix Spike
MD	Matrix Duplicate
NAD	North Atlantic Datum
NAVD	North Atlantic Vertical Datum
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJRDCSCC	New Jersey Residential Direct Contact Soil Cleanup Criteria
NPL	National Priorities List
NTP	Notice-To-Proceed
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PM	Project Manager
PG	Professional Geologist
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QAC	Quality Assurance Coordinator
QAM	Quality Assurance Manager
QC	Quality Control
ROD	Record of Decision
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan

SCBA	Self-Contained Breathing Apparatus
SES	Sevenson Environmental Services, Inc.
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
SOW	Statement of Work
TCLP	Toxicity Characteristic Leaching Procedure
TM	Task Manager
TSOP	Technical Standard Operating Procedure
USACE	United States Army Corps of Engineers

TABLE 4-1
SAMPLE SUMMARY TABLE
OU3 BLACKWATER BRANCH INVESTIGATION
VINELAND CHEMICAL SUPERFUND SITE
Vineland, NJ

BASE WORK

						Field Samples	QA/QC samples					
Parameter	Matrix	Analytical Method	Sample Volume	Sample Preservation	Holding Time	Sample Quantity	Duplicates (5%)	MS (5%)	MSD (5%)	Equip Rinsate (Daily)	TAT Required	Total Number of Samples
Bulk Sediment												
Total Arsenic	Sediment	SW 846 3050B/6010B (Soil) and 3020A/6010B (Aqueous)	Sediment: 4 oz. jar Equip Rinsate: 1 L HDPE	Cool to 4° C (sediment and aqueous) Equip Rinsate: HNO_3 to pH < 2	180 days	265	14	14	14	10	2 Day	317
Geotechnical												
Grain Size	Sediment	ASTM D 422-63	500 mL CWM	None	None	27	0	0	0	0	28 Day	27
TCLP												
TCLP Arsenic	Sediment	SW 846 1311/6010B	500 mL CWM	None (see notes)	180 days	5	0	0	0	0	28 Day	5
					LAB TOTALS	297	14	14	14	10		349

OPTION 1

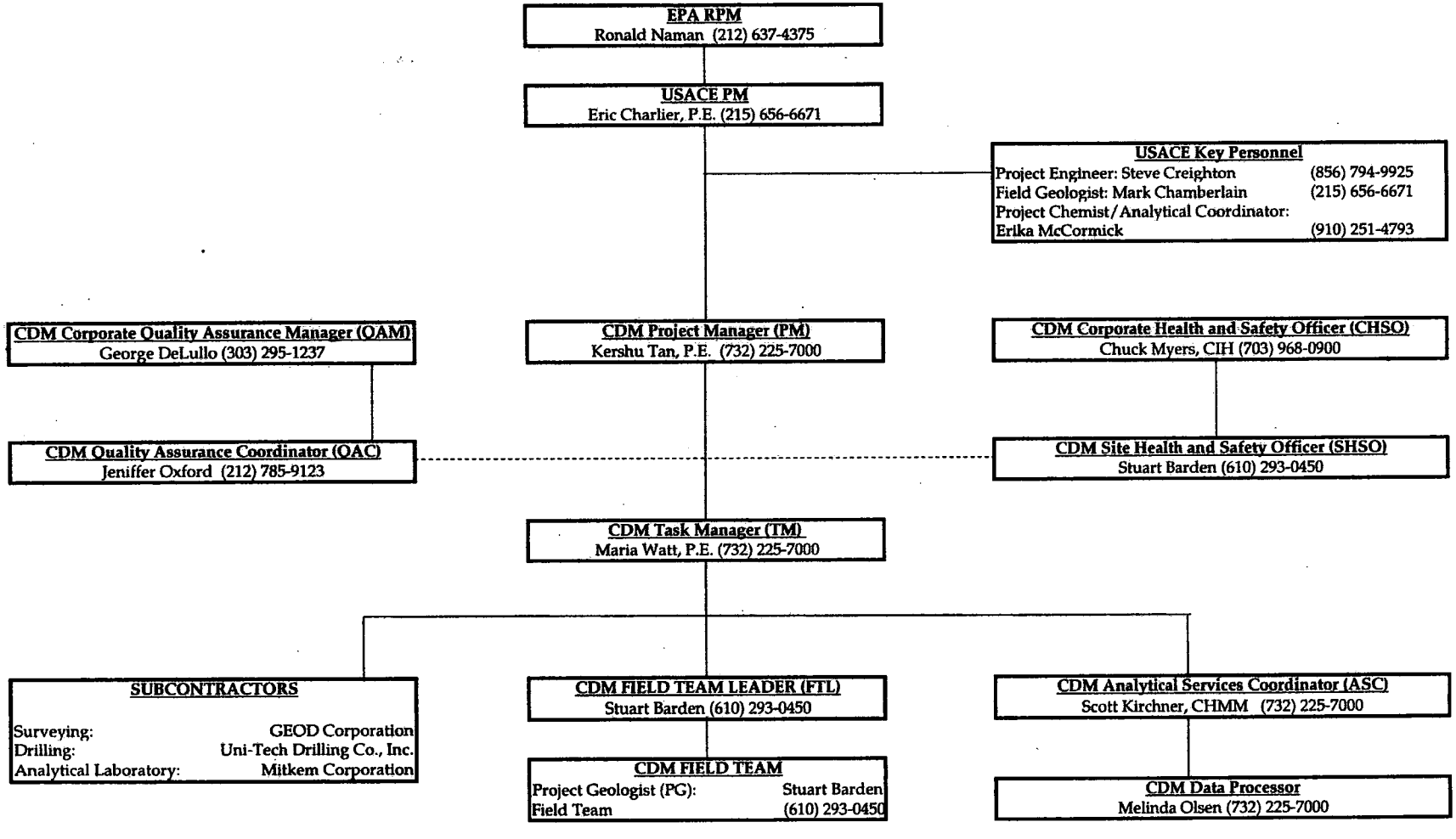
						Field Samples	QA/QC samples					
Parameter	Matrix	Analytical Method	Sample Volume	Sample Preservation	Holding Time	Sample Quantity	Duplicates (5%)	MS (5%)	MSD (5%)	Equip Rinsate (Daily)	TAT Required	Total Number of Samples
Bulk Sediment												
Total Arsenic	Sediment	SW 846 3050B/6010B (Soil) and 3020A/6010B (Aqueous)	Sediment: 4 oz. jar Equip Rinsate: 1 L HDPE	Cool to 4° C (sediment and aqueous) Equip Rinsate: HNO_3 to pH < 2	180 days	100	5	5	5	5	28 Day	120
					LAB TOTALS	100	5	5	5	5		120

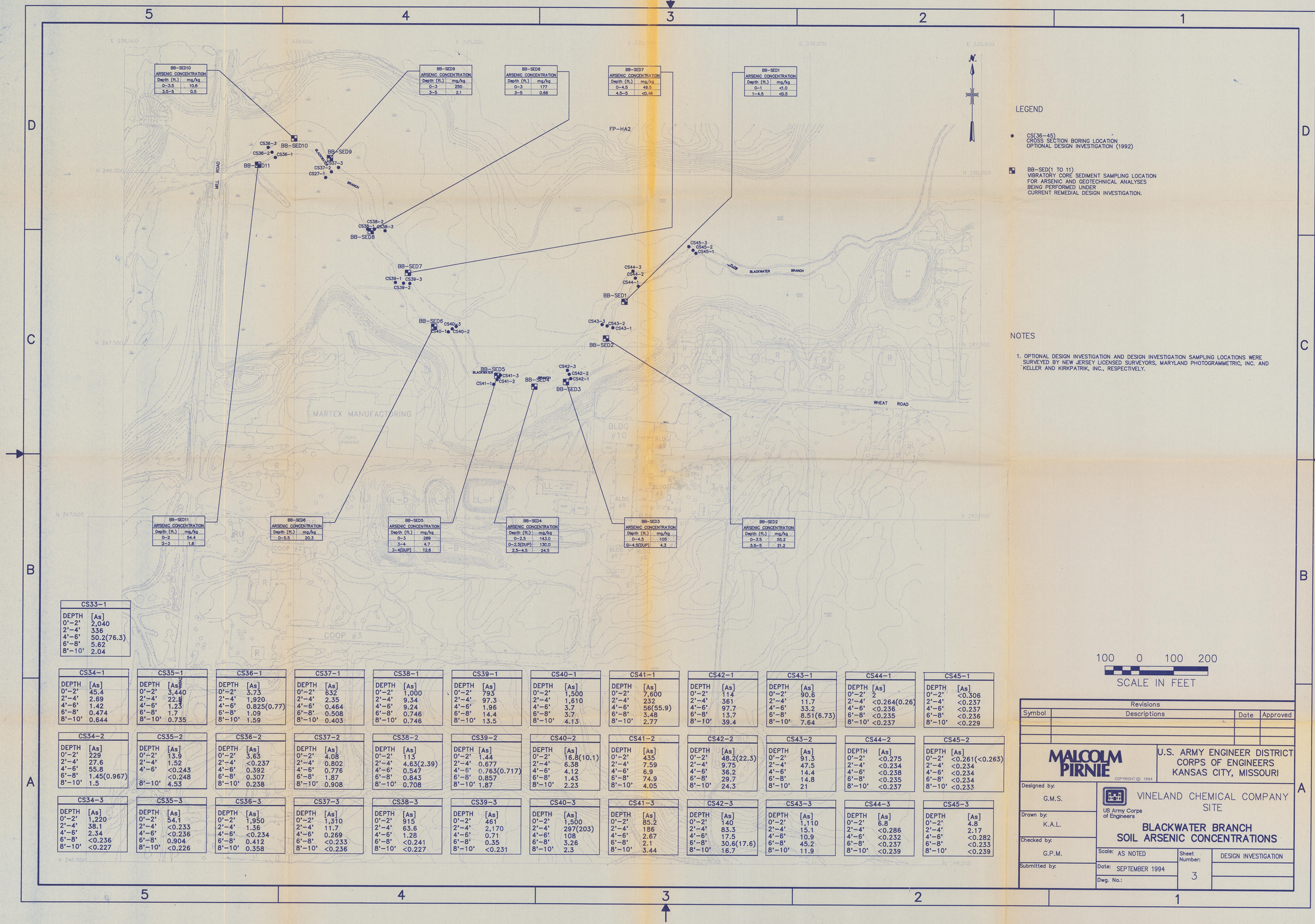
Notes

1. All sampling (Base and Option 1) to be performed under a single field mobilization. Assumes 10 working days for base work, and up to 5 working days for Option 1.
2. Option 1 is for the collection of up to 100 additional samples. Sample quantities represent the upper limit.
3. MS/MSD analyses will not require additional sample volume.
4. TCLP preservation requirement (Cool to 4°C) has been waived by USACE to accommodate on-site storage of sample material pending TCLP and Grain Size interval selection.

MS/MSD - Matrix Spike and Matrix Spike Duplicate
TAT - Turnaround time
TCP - Toxicity Characteristic Leaching Procedure
ASTM - American Society of Testing and Materials
CWM - Clear wide-mouth glass jar with teflon-lined lid
HDPE - High density polyethylene bottles

Figure 2-1
Project Organizational Chart
Vineland Chemical Company Superfund Site





LEGEND

- CS(36-45) CROSS SECTION BORING LOCATION OPTIONAL DESIGN INVESTIGATION (1992)
- BB-SED(1 TO 11) VIBRATORY CORE SEDIMENT SAMPLING LOCATION FOR ARSENIC AND GEOTECHNICAL ANALYSES BEING PERFORMED UNDER CURRENT REMEDIAL DESIGN INVESTIGATION.

NOTES

1. OPTIONAL DESIGN INVESTIGATION AND DESIGN INVESTIGATION SAMPLING LOCATIONS WERE SURVEYED BY NEW JERSEY LICENSED SURVEYORS, MARYLAND PHOTOGRAMMETRIC, INC. AND KELLER AND KIRKPATRIK, INC., RESPECTIVELY.

CS33-1

DEPTH	[As]
0'-2'	2,040
2'-4'	336
4'-6'	50.2(76.3)
6'-8'	5.62
8'-10'	2.04

CS34-1

DEPTH	[As]
0'-2'	45.4
2'-4'	2.69
4'-6'	1.42
6'-8'	0.474
8'-10'	0.644

CS35-1

DEPTH	[As]
0'-2'	3,440
2'-4'	22.1
4'-6'	1.23
6'-8'	1.7
8'-10'	0.735

CS36-1

DEPTH	[As]
0'-2'	3.73
2'-4'	1,920
4'-6'	0.825(0.77)
6'-8'	1.09
8'-10'	1.59

CS37-1

DEPTH	[As]
0'-2'	632
2'-4'	2.35
4'-6'	0.464
6'-8'	0.508
8'-10'	0.403

CS38-1

DEPTH	[As]
0'-2'	1,000
2'-4'	9.34
4'-6'	9.24
6'-8'	0.746
8'-10'	0.746

CS39-1

DEPTH	[As]
0'-2'	793
2'-4'	97.3
4'-6'	1.96
6'-8'	14.4
8'-10'	13.5

CS40-1

DEPTH	[As]
0'-2'	1,500
2'-4'	1,610
4'-6'	3.7
6'-8'	3.7
8'-10'	4.13

CS41-1

DEPTH	[As]
0'-2'	7,600
2'-4'	232
4'-6'	56(55.9)
6'-8'	3.48
8'-10'	2.77

CS42-1

DEPTH	[As]
0'-2'	114
2'-4'	361
4'-6'	97.7
6'-8'	13.7
8'-10'	39.4

CS43-1

DEPTH	[As]
0'-2'	90.6
2'-4'	11.7
4'-6'	33.2
6'-8'	8.51(6.73)
8'-10'	7.64

CS44-1

DEPTH	[As]
0'-2'	2
2'-4'	<0.264(0.26)
4'-6'	<0.236
6'-8'	<0.235
8'-10'	<0.237

CS45-1

DEPTH	[As]
0'-2'	<0.306
2'-4'	<0.237
4'-6'	<0.237
6'-8'	<0.236
8'-10'	<0.229

CS34-2

DEPTH	[As]
0'-2'	229
2'-4'	27.6
4'-6'	55.8
6'-8'	1.45(0.967)
8'-10'	1.5

CS35-2

DEPTH	[As]
0'-2'	13.9
2'-4'	1.52
4'-6'	<0.243
6'-8'	<0.248
8'-10'	4.53

CS36-2

DEPTH	[As]
0'-2'	3.63
2'-4'	<0.237
4'-6'	0.392
6'-8'	0.307
8'-10'	0.238

CS37-2

DEPTH	[As]
0'-2'	4.08
2'-4'	0.802
4'-6'	0.776
6'-8'	1.87
8'-10'	0.908

CS38-2

DEPTH	[As]
0'-2'	113
2'-4'	4.63(2.39)
4'-6'	0.547
6'-8'	0.843
8'-10'	0.708

CS39-2

DEPTH	[As]
0'-2'	1.44
2'-4'	0.677
4'-6'	0.763(0.717)
6'-8'	0.857
8'-10'	1.87

CS40-2

DEPTH	[As]
0'-2'	16.8(10.1)
2'-4'	6.38
4'-6'	4.12
6'-8'	1.43
8'-10'	2.23

CS41-2

DEPTH	[As]
0'-2'	435
2'-4'	7.59
4'-6'	6.9
6'-8'	74.9
8'-10'	4.05

CS42-2

DEPTH	[As]
0'-2'	48.2(22.3)
2'-4'	9.75
4'-6'	36.2
6'-8'	29.7
8'-10'	24.3

CS43-2

DEPTH	[As]
0'-2'	91.3
2'-4'	47.5
4'-6'	14.4
6'-8'	14.8
8'-10'	21

CS44-2

DEPTH	[As]
0'-2'	<0.275
2'-4'	<0.234
4'-6'	<0.238
6'-8'	<0.235
8'-10'	<0.237

CS45-2

DEPTH	[As]
0'-2'	<0.261(<0.263)
2'-4'	<0.234
4'-6'	<0.234
6'-8'	<0.234
8'-10'	<0.233

CS34-3

DEPTH	[As]
0'-2'	1,220
2'-4'	38.1
4'-6'	2.34
6'-8'	<0.236
8'-10'	<0.227

CS35-3

DEPTH	[As]
0'-2'	54.1
2'-4'	<0.233
4'-6'	<0.236
6'-8'	0.904
8'-10'	<0.226

CS36-3

DEPTH	[As]
0'-2'	1,950
2'-4'	1.36
4'-6'	<0.234
6'-8'	0.412
8'-10'	0.358

CS37-3

DEPTH	[As]
0'-2'	1,310
2'-4'	11.7
4'-6'	0.269
6'-8'	<0.233
8'-10'	<0.236

CS38-3

DEPTH	[As]
0'-2'	915
2'-4'	63.6
4'-6'	1.28
6'-8'	<0.241
8'-10'	<0.227

CS39-3

DEPTH	[As]
0'-2'	461
2'-4'	2,170
4'-6'	0.71
6'-8'	0.35
8'-10'	<0.231

CS40-3

DEPTH	[As]
0'-2'	1,500
2'-4'	297(203)
4'-6'	108
6'-8'	3.26
8'-10'	2.3

CS41-3

DEPTH	[As]
0'-2'	85.2
2'-4'	186
4'-6'	2.67
6'-8'	2.1
8'-10'	3.44

CS42-3

DEPTH	[As]
0'-2'	140
2'-4'	83.3
4'-6'	17.5
6'-8'	30.6(17.6)
8'-10'	16.7

CS43-3

DEPTH	[As]
0'-2'	1,110
2'-4'	15.1
4'-6'	10.9
6'-8'	45.2
8'-10'	11.9

CS44-3

DEPTH	[As]
0'-2'	6.8
2'-4'	<0.286
4'-6'	<0.232
6'-8'	<0.237
8'-10'	<0.239

CS45-3

DEPTH	[As]
0'-2'	4.8
2'-4'	2.17
4'-6'	<0.282
6'-8'	<0.233
8'-10'	<0.239

100 0 100 200
SCALE IN FEET

Revisions			
Symbol	Descriptions	Date	Approved

MALCOLM PIRNIE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by: G.M.S.
Drawn by: K.A.L.
Checked by: G.P.M.
Submitted by:

US Army Corps of Engineers

VINELAND CHEMICAL COMPANY SITE

BLACKWATER BRANCH SOIL ARSENIC CONCENTRATIONS

Scale: AS NOTED
Date: SEPTEMBER 1994
Dwg. No.:
Sheet Number: 3

DESIGN INVESTIGATION

3578 : D285525250\\:\ACAD\PROJ\D285525\E SCALE: 1:100 09/29, 1994 at 14:15

E 334,500 E 335,000 E 335,500 N 248,000 N 247,500

NOTE: FIGURE GENERATED FROM BASEMAP CAD FILE PROVIDED BY USACE FROM THE MALCOLM PIRNIE SOURCE CONTROL REMEDIATION DESIGN.

LEGEND

- PROPOSED SEDIMENT SAMPLING LOCATION
- PREVIOUS SAMPLING LOCATION TO BE RESAMPLED (SEE TABLE BELOW)
- ST-1 PROPOSED STREAM TRANSECT LOCATION
- EXISTING EXTRACTION WELLS

PREVIOUS SAMPLING LOCATIONS TO BE RESAMPLED

NEW SAMPLE ID	PREVIOUS SAMPLE LOCATION	DEPTH INTERVAL TO BE RESAMPLED
EIB-170	BB-SED5	0-36 INCHES 36-48 INCHES 48-54 INCHES
EIB-171	BB-SED7	0-54 INCHES 54-60 INCHES
EIB-172	BB-SED9	0-3 FEET 3-5 FEET
EIB-173	SB-37	0-2 FEET 2-4 FEET
EIB-174	SB-44	0-2 FEET 2-4 FEET 4-6 FEET
EIB-175	SB-45	0-2 FEET 2-4 FEET
EIB-176	SB-46	0-2 FEET 2-4 FEET 4-6 FEET
EIB-177	FB-19	0-2 FEET 2-4 FEET 4-6 FEET

Revisions

Symbol	Descriptions	Date	Approved

CDM FEDERAL PROGRAMS CORPORATION

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
PHILADELPHIA, PENNYSYLVANIA

Designed by: J.M.
Drawn by: J.A.
Checked by: G.C.
Submitted by: K.T.

VINELAND CHEMICAL SUPERFUND SITE
OU3 BLACKWATER BRANCH
US Army Corps of Engineers

PROPOSED STREAM TRANSECTS AND SAMPLE LOCATIONS

Scale: 1" = 100'
Date: JANUARY 2005
No.:
Sheet number: 3-1
Plot Scale: 2:1
Design File: FIGURE 3-1
File No.:

1" = 100'
25 0 50

PAYS

Figure 5-1

Daily Quality Control Report

DATE: _____

Contractors and Personnel Onsite: _____

_____

_____

_____

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temperature	To 32	32 to 50	50 to 70	70 to 85	85 - Up
Wind	Still	Moderate	High		
Humidity	Dry	Moderate	Humid		

Description of Daily Field Activities:

Issues/Problems Encountered/Deviations from SAP:

Prepared by: _____

Page ___ of ___

FIGURE 5-2 SAMPLE TRACKING LOG

VINELAND CHEMICAL SUPERFUND SITE
OU3 BLACKWATER BRANCH FIELD INVESTIGATION

SUBCONTRACT LAB: _____

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	MATRIX	DEPTH (feet)	Analytical Parameters			QA/QC	
					Total Arsenic SW 846 6010B	**Grain Size** ASTM D2487	**TCLP arsenic** SW 846 1311/ 6010B	**MS/MSD**	**Field Duplicate Sample** identify parent sample

NOTES/: _____

Field Change Request (FCR) Form
Vineland Chemical Superfund Site
Vineland, New Jersey

Request No: _____ Date: _____

FCR Title: _____

Description: _____

_____

_____

Reason for Deviation: _____

_____

_____

_____

Recommended/modification: _____

_____

_____

_____

_____

Signatures: FTL _____ _____
Date

CDM Project Manager _____ _____
Kershu Tan, P.E. Date

CDM QAC _____ _____
Jeniffer Oxford Date

Distribution: R. Naman, EPA Remedial Project Manager
E. Charlier, USACE Project Manager
K. Tan, CDM Project Manager
M. Watt, CDM Task Manager
Stuart Barden, CDM FTL
J. Oxford, CDM QAC
Field Team
Project File

Figure 5-3
Field Change Request Form
Vineland Chemical Superfund Site

CDM

Field Sampling Plan
APPENDIX A

CDM Resumes

Stuart Barden

Geologist

Education

M.S. Geology, San Diego State University, 2002

M.A. Liberal Studies, St. John's College, 1991

B.A. Geology, Franklin and Marshall College, 1988

Mr. Barden has five years of experience as a geologist and environmental scientist. His experience includes field team leader activities, soil and groundwater sampling, hydrogeologic testing, contaminant plume delineation, lithologic logging and interpreting geological and hydrogeologic data for various projects. He provides technical and supervisory support for borehole and well drilling, soil and groundwater sampling using various sampling techniques, and hydrogeologic testing for remedial investigations and feasibility studies in planning, fieldwork, data interpretation, and reporting stages. Since coming to CDM, he has worked on four sites, all of which are on the NPL.

Mr. Barden has provided technical field and reporting support to EPA Region III for CERCLA and RCRA related activities. His responsibilities, in addition to field support, include technical assistance with RI/FS reporting, groundwater monitoring reports, and SOW preparation.

CDM, Wayne, PA: Geologist, 2004-Present

Field Geologist. North Penn Area 7 Superfund Site, North Wales, PA. Mr. Barden has prepared final boring logs and provided technical assistance for preparation of monitoring well installation.

Experience Highlights

- Subsurface Soil Sampling Team Leader – U.S. Navy, SWDIV, Remedial Investigation, Seal Beach, CA – Geoprobe® and HSA subsurface soil logging of coastal sediments using USCS
- Field Team Leader – California Department of Transportation Route 125 Storm Water and Sediment Quality Monitoring Program
- Field Team Leader – E.I. DuPont, Logged coastal plain sediments at DuPont's Deepwater NJ, New Castle DE, Edgemoor DE, and Seaford DE facilities

Field Geologist. Salford Quarry Superfund Site, Lower Salford Township, PA. Mr. Barden has performed groundwater, surface water, and sediment-sampling duties related to Boron contaminant delineation and characterization. Provided technical assistance for preparation of monitoring reports and prepared subcontractor IFBs.

Field Geologist. Hellertown Manufacturing Superfund Site, Hellertown, PA. Mr. Barden has performed groundwater-sampling duties related to TCE groundwater monitoring events and reporting. Provided operation and maintenance support and system performance sampling related to discharge monitoring reporting (DMR) for pump and treat system. Provided technical assistance for Semi-Annual Groundwater Monitoring Report, SOW preparation, and DMR submission.

Field Geologist. Maryland Sand, Gravel, and Stone Superfund Site, Cecil County, MD. Mr. Barden has reviewed work plans and performed site inspections.

Previous Work

Field Geologist. For Brown and Caldwell, in California, Mr. Barden planned, coordinated, and performed field projects. His experience includes

extensive logging of soil borings using the Unified Soil Classification System (USCS) in coastal and upland geologic settings. He directed and oversaw monitoring well installation, soil borings, subsurface soil sampling, groundwater sampling, and hydrogeologic testing. Mr. Barden has prepared groundwater monitoring reports, technical memoranda, and project planning documents for U.S. Navy Southwest Division. He also performed data evaluation and preliminary screening for human health risk assessments.

Field Geologist. For E.I. DuPont de Nemours and Co., Inc., in Delaware, Mr. Barden supervised environmental field service activities for numerous projects located in various states. Mr. Barden has planned, directed, and executed a range of geologic and hydrogeologic investigations including installation of monitoring wells and drilling soil borings, lithologic logging, hydrogeologic testing, and subsurface soil and groundwater sampling. He was also responsible for developing and implementing sampling plans, and health and safety plans, directing and monitoring field teams, interfacing with analytical laboratories, directing and overseeing drilling subcontractors, coordinating with regulatory agencies; evaluating chemical and geologic data, and preparing reports.

Professional Activities

Member, National Ground Water Association

George C. DeLullo

Quality Assurance Director

Education

M.B.A. – Technical Management, Regis College (1985)

M.S. - Inorganic Chemistry, University of Nevada-Reno (1979)

B.S. - Chemistry, University of Nevada-Las Vegas (1977)

Mr. DeLullo is the CDM Federal's Quality Assurance Director, responsible for development and implementation of the firm's corporate quality assurance program. He has over 25 years of experience initially as a radiochemist with 15 of the last years in the quality assurance/quality control field. Mr. DeLullo has extensive experience with various Federal Government agency quality assurance programs including U.S. Environmental Protection Agency (EPA), U. S. Department of Energy (DOE) and U.S. Department of Defense (DOD). He has developed corporate and contract-specific QA/QC programs to meet those and other government program requirements. Mr. DeLullo is currently approved as an ANSI/ASME NQA-1 certified lead auditor.

Experience

As Quality Assurance (QA) Director, Mr. DeLullo is responsible for development and implementation of the firm's quality assurance program. He works with senior management in defining and strategizing the firm's quality management philosophy. Mr. DeLullo works closely with senior management to continually improve the quality management program. He frequently monitors client quality programs to ensure the firm's compliance with those requirements. His responsibilities include ensuring the quality assurance program is effectively implemented, providing a framework of appropriate quality control procedures, selecting projects for audit, initiation of and follow-up on corrective actions, and interfacing with clients, subcontractors and project staff. He directs and implements revisions to the quality assurance program and the firm's technical standard operating procedures. He is also directly responsible for oversight of 30+ quality personnel and their quality assurance related activities; audits, surveillances, annual quality plans, quality training, etc. in CDM Federal's offices.

Experience Highlights

- Management of corporate Quality Assurance Program – Interface with senior management
- Evaluation of federal client requirements, both in quality and chemistry
- Radiological and chemical demilitarization – technical experience

Mr. DeLullo directs the preparation of and develops Quality Management Plans (QMPs) for several contracts. For EPA, those plans comply with EPA QA/R-2 requirements which are based on ANSI/ASQC E-4 standards. He also conducts annual management systems reviews on EPA Region II and VIII contracts to ascertain the overall implementation of the QMPs.

As a headquarters (HQ) QA Specialist for six years and West Division QA Specialist for four years previous to that time, Mr. DeLullo was responsible for quality assurance program implementation. His chemistry expertise was also utilized in determining chemistry requirements for various projects including, CWA, SDWA, RCRA, and CERCLA related sites. He provided QA oversight, reviews, and guidance in conjunction with CDM Federal's

remedial investigations and feasibility studies (RI/FS), risk assessments (RA), remedial designs (RD), and other firm projects requiring QA/QC requirements expertise. Additional responsibilities included reviewing and recommending analytical laboratory subcontractors for CDM Federal contracts. He is also an expert in evaluating laboratory technical and QA capabilities for use in CDM Federal projects and/or contracts. He has also written and evaluated laboratory statements of work (SOWs) and basic ordering agreements (BOAs) for several CDM Federal contracts including ones with the U.S. Army Corp of Engineers-Tulsa, DOD, EPA, DOD, and U.S. Forest Service (USFS). QA responsibilities include conducting, coordinating, and approving QA audits and surveillances associated with CDM Federal's ARCS Region I, ARCS Region II, Brookhaven, ARCS Regions VI-VIII, USACE, EMO, Sandia, HAZWRAP, USFS, USAFA, TES, OII, and Navy DOD projects. He is also authorized to QA review measurement reports, procurement subcontracts, QA project plans, sampling and analysis plans, and work plans. In addition, he also trains QA staff to review procurement documents and field plans and to conduct office audits.

Mr. DeLullo has been the responsible QA designee for several CDM Federal projects. These include several EPA ARCS Regions VI-VIII projects (Anaconda, Butte/Silver Bow Creek, Petrochem, Rocky Mountain Arsenal, Chemical Sales Company, Sharon Steel, Popile, and American Creosote) and RAC VIII projects (California Gulch, Summitville, Kennecott, Anaconda, and Silver Bow Creek), USACE-Omaha projects (Thermo-Chem and Williston), USACE-Tulsa (Sheppard AFB and Altus AFB) USACE-Walla Walla (North Slope and Ice Harbor), Department of Transportation-Volpe Center (Libby, Montana), Department of Energy projects (Los Alamos and Sandia), EMO projects (Tinker AFB), and several Navy DOD projects. Mr. DeLullo has conducted QA audits and surveillances associated with these projects and implement the overall QA program for the CDM Federal's Cambridge, New York/New Jersey, and Atlanta offices in the East Area and all offices in the West Area.

Because of his chemistry and laboratory background, Mr. DeLullo provides CDM Federal with expertise in evaluating laboratory technical and QA capabilities for use in CDM Federal projects and proposals. He has written and evaluated laboratory statements of work (SOWs) and basic ordering agreements (BOAs) for several CDM Federal contracts including Oak Ridge (DOE), ARCS Region VI-VIII (EPA), RAC Region VIII (EPA), USACE (Tulsa), U.S. Air Force Academy (Air Force), and the USFS.

Mr. DeLullo has extensive experience as an Environmental Engineer including hazardous waste determination, sampling, data review, labeling/marking containers, inventory, shipment, and accountability according to RCRA, CERCLA, and TSCA regulations. He has also written RCRA Part B permit revisions, writing portions of the annual noncompliance report for EPA, and generated weekly environmental status reports to the client.

In 1997, Mr. DeLullo evaluated the chemical compatibility of waste with primary and secondary storage containers at the waste storage facilities located at the DOE's Paducah Gaseous Diffusion Plant (PGDP). In addition, he evaluated waste management vulnerabilities associated with hazards created from waste storage, waste documentation, and regulatory vulnerabilities. He evaluated overall waste management activities including waste personnel training, adequacy of standard operating procedures, waste inspection and overall waste management communication and documentation. Waste compatibility support included evaluating hazardous, low-level PCB, and environmental restoration (ER) wastes.

As an ANSI/ASME NQA-1 certified lead auditor at the DOE Rocky Flats Plant in Golden, Colorado, Mr. DeLullo audited several areas of the plant including procurement, special order work, production operations procedures, special and improvement war-related (WR) processing and drawing/specification quality requirements.

As a radiochemist at Rocky Flats, Mr. DeLullo analyzed and evaluated low and medium level radioactive samples including process waste from buildings and environmental samples from around the plant-site. He also evaluated radiochemical methods, procedures, and quality control.

By working as a chemist at EPA in their EMSL-Las Vegas laboratory, Mr. DeLullo monitored and evaluated quality control, personnel, and instrumentation of radiochemical laboratories participating in the Radiation Intercomparison Studies Program in compliance with the Primary Drinking Water Regulations.

CDM, Denver, CO: Corporate QA Director (August 2002 – Present) and QA Specialist/HQ QA Specialist (1991 – August 2002).

Mr. DeLullo has over a year and a half experience as CDM Federal's QA Director. He has conducted management systems reviews (MSRs) for EPA RACs in both Regions II and VIII. He has managed CDM's quality program involvement with several federal clients. As a QA Specialist, Mr. DeLullo had 10+ years of experience in performing QA and chemistry functions for several CDM Federal projects. Specific contracts include EPA ARCS VI-VIII and RAC VIII, USACE-Omaha, USACE-Tulsa, USACE-Walla Walla, EMO-Tinker AFB, HAZWRAP-Norton AFB, U.S. Forest Service, Bureau of Reclamation, Volpe Transportation Center, Government Services Administration (GSA), Navy Southwest Division, and DOE-Sandia, Los Alamos, and Paducah. Mr. DeLullo has performed over fifty audits and surveillances and QA reviewed several hundred documents including work plans, sampling and analysis plans, quality assurance project plans, field sampling plans, measurement reports, and procurement subcontract documents. Mr. DeLullo is responsible for reviewing technical and QA staff audits and surveillance reports on projects in his area and issuing them. As an ANSI/ASME NQA-1 certified lead auditor, Mr. DeLullo has conducted NQA-1 audits of HAZWRAP projects. He has prepared laboratory .

subcontractor statements of work (SOWs) and basic ordering agreements (BOAs) containing various analysis methods including CLP, SW-846, EPA Test Methods Series 200-600, Standard Methods, and ASTM for several CDM Federal contracts including EPA RAC VIII and ARCS VI-VIII, USACE-Tulsa, USACE-Omaha, USAFA, Oak Ridge, and USFS.

Mr. DeLullo has also contributed laboratory and QA sections for several proposals including AFCEE, USFS, TERC, USAEC, Volpe Transportation Center, RACs, and Sandia-Livermore. Mr. DeLullo provides chemistry expertise to CDM Federal technical staff in areas of waste management, laboratory methods, QA capabilities, and laboratory statements of work. His involvement has spanned almost all of CDM Federal's Area offices.

United Engineers and Constructors, Johnston Atoll, Pacific Ocean; Environmental Engineer, 1990-1991.

Mr. DeLullo had over 1 ½ years of experience in RCRA compliance at the JACADS chemical demilitarization facility located on Johnston Atoll. He monitored regulatory developments at the plant in the areas of air, water, soil, and solid/hazardous/toxic materials and wastes. His experience included hazardous waste sampling and determination, date review, labeling/marking containers, addressing EPA Notices of Violation, and chemical demilitarization hazardous waste inventory/shipment/accountability according to RCRA, CERCLA, and TSCA regulations. Mr. DeLullo coordinated the hazardous waste shipments of several tons of lead/cadmium contaminated chemical demilitarization rocket debris, scrubber brine, and incinerated liquid waste. He was also involved in submitting JACADS plant RCRA Part B permit revisions (plant modifications), contributing several sections of the annual noncompliance report to EPA, and generating weekly environmental reports to the client.

Rockwell International Corporation, Rocky Flats Plant, Golden, CO; Principal Auditor, 1988-1990.

Mr. DeLullo had over 2 years of experience in evaluating the adequacy and effectiveness of the Rocky Flats Plant quality program activities as an ANSI/ASME NQA-1 certified lead auditor. He audited several areas of the plant including procurement, quality engineering, special order work, production operations procedures, nuclear criticality, special and improvement war-related processing, and drawing/specification quality requirements.

Rockwell International Corporation Rocky Flats Plant, Golden, CO; Principal Health Physicist, 1986-1988.

Mr. DeLullo had over 2 years of experience as Technical Leader for low-level radiation and dosimetry counting in the multi-million dollar alpha and gamma spectroscopy areas. Mr. DeLullo performed analyses and evaluated data for thousands of environmentally related samples acquired throughout

the Rocky Flats Plant boundaries. His expertise included use and calibration of several radiation detecting instruments. He worked with and made recommendations to all levels of management in the radiation dosimetry department.

Rockwell International Corporation, Rocky Flats Plant, Golden, CO; Senior Analytical Chemist, 1983-1986.

Mr. DeLullo had over 3 years of experience in evaluating radiochemical methods, procedures, development, and quality control. He instructed several radiochemistry technicians on radiochemical techniques and methods including gamma emitters, alpha and beta emitters, tritium, and actinides. As a chemist, he determined customer needs, requirements, and deadlines for sample analyses.

U.S. Environmental Protection Agency, EMSL-Las Vegas, Las Vegas, NV; Chemist, 1979-1983.

Mr. DeLullo had over 3 years of experience monitoring and evaluating quality control, personnel, and instrumentation of over 200 radiochemical laboratories on the national level for radiochemical compliance with the Primary Drinking Water Regulations. He also certified several private and state laboratories participating in the EPA Radiation Intercomparison Studies Program.

Honors/Awards

1995 - CDM Federal Programs "Pride" Award

1992 - CDM Federal Programs "Pride" Award

1982 – EPA Outstanding Employee Award

Professional Activities

Member - American Society for Quality Control, 1981

Member - American Chemical Society, 1982

Member - American Nuclear Society, 1988

Clearances

USDOE "Q" Clearance - Rocky Flats Plant, 1983-90 (currently inactive)

Publications

Nelson, J.H., P.N. Howells, G.C. DeLullo, G.L. Landen and R.A. Henry, 1980. Nickel Catalyzed Michael Additions of beta - Dicarbonyls. Journal of Organic Chemistry 45:7.

Splichal L. and G.C. DeLullo, 2001. Using Field Data Analysis for Environmental Decision Making and Subsequent Remediation at Two Example Sites. Presented at the American Society for Quality (ASQ) Twentieth Annual National Conference on Managing Quality Systems for Environmental Programs, St. Louis, MO. April 2-6, 2001 and subsequently published in *Quality Assurance*, Volume 8, Numbers 3-4, July-December 2001, pp. 205-223.

Scott F. Kirchner

Environmental Scientist

Education

B.S., Chemistry, Stockton State College, 1987

Over 40 semester hours in chemistry related fields

B.S., Environmental Science, Stockton State College, 1987

Registration

Certified Hazardous Materials Manager, ID No. 2602, 1991

NJDEP Radon Measurement Specialist, 1997, Cert. No. MES10908

American Chemical Society, ID No. 1786527T

Experience Highlights

- Over 11 years chemistry support of remedial investigations
- Over 7 years analytical chemistry experience, 5 with a commercial laboratory with inorganic and organic analytical experience, and over 2 years with a NJ State DEP water classification laboratory.
- Extensive onsite knowledge of remedial investigations as sampler, field analyst and site manager.
- Has been responsible for the proper handling of toxic and hazardous materials for over 16 years.

Mr. Kirchner is the Analytical Services Coordinator for CDM's NY/NJ offices supporting all their U.S. Environmental Protection Agency (USEPA) Region 2 and U.S. Army Corps of Engineers (USACE) sites. He has over 12 years experience dealing with the investigation of chemical contamination and remediation at dozens of hazardous waste sites. Mr. Kirchner has in-depth knowledge of the remedial process, fate and transport of organic and inorganic contaminants. He has provided consistent chemical quality control, sampling, analysis and data validation support for CDM's NY/NJ offices on virtually all their superfund and USACE sites both in and outside of Region 2. Mr. Kirchner has extensive onsite experience in the collecting, field screening, and analysis of contaminated soil, water, hazardous waste, and air samples.

Prior to joining CDM Mr. Kirchner was employed by a commercial environmental analytical laboratory for 5 years. His duties included the supervision of inorganics laboratory. During this period he was responsible for the quality of all data generated by his laboratory section. This included the review of data generated by the ICP, GFAA, AA, CVAA and various wet chemistry procedures performed on a soil, water, waste, air cartridges and a variety of unique matrices. Mr. Kirchner also performed GC/MS analyses for several years while with the company. These duties included the preparation, analysis, interpretation, and reporting of results. All of the laboratory activities were performed with strict adherence to laboratory, state and federal QA/QC requirements.

Experience

CDM, South Plainfield, NJ, Environmental Scientist, 1992 – Present

Information Management Solutions Team Leader

Responsible for the development of GIS and database procedures and protocols for tracking information, deploying GIS/data reporting services for NY/NJ CDM offices. Tracking budgets for GIS and data base management tasks. Coordinating GIS and data management staff. Conducting performance reviews for IMS Team. Providing innovative approaches to evaluating and distributing site data.

Remedial Investigations/Feasibility Studies

Mr. Kirchner has over 10 years of experience in performing RI/FS field activities or PRP oversights at over 17 sites, all of which are on the NPL. He

has managed field activities, written RI reports and prepared numerous field and data comparison reports of PRP oversight activities.

U.S. EPA; Long-Term Monitoring RI/FS Oversight, PREPA Palo Seco Superfund Site, Toa Baja, Puerto Rico - Site Manager. Mr. Kirchner prepared costing portion of site work plans revised QAPP, prepares monthly budget and job tracking reports. He oversees field investigation activities, sampling reports, and split sampling evaluation reports. Mr. Kirchner also coordinates scheduling and resources to provide EPA oversight of PRP activities and reviews PRP report documents. The PREPA site is an active steam generating plant with vigorous community interest.

Instituted a cooperative review process using conference calls, sit down and net meetings for initial PRP data presentation/discussion and PRP comment responses for several project deliverables and data gap sampling plans. This process fostered greater buy in from PRP and streamlined the comment/response process. The project, which languished for over a year, is now back on track and progressing steadily.

US EPA, Long-Term Monitoring, Operation & Maintenance Oversight, Swope Oil & Chemical Site, Pennsauken, NJ - Site Manager. Mr. Kirchner prepared site work plan revised QAPP, prepares monthly budget and job tracking reports. He oversees the preparation of field activity, quarterly O&M and sampling reports, and split sampling evaluation reports. Mr. Kirchner also coordinates scheduling and resources to provide EPA oversight of PRP activities. The PRP activities included quarterly

USACE, US Radium Superfund Site, Radiological Contamination Investigation, West Orange and Glen Ridge, NJ – Radon Measurement Specialist. Mr. Kirchner performed in home testing using alpha track and radon gas (GAC) canister sampling devices to evaluate levels of radiation contamination. The investigation also included the use of portable radiation detectors and soil sampling for laboratory analysis to evaluate nature and extent of radiological contamination at this mega-site. Mr. Kirchner was one of two radon measurement specialists providing interpretation and validation of radiological data received from the subcontract laboratory in support of the ongoing investigation and post cleanup confirmations.

USEPA RAC II, RI/FS, Zschiegner Refining Company Site, Howell Township, Monmouth County, NJ - Field Team Leader. Mr. Kirchner was responsible for the successful implementation of the Project Operations Plan at the site. He coordinated all field activities for the RI/FS including determination of nature and extent of contaminant using Geoprobe and onsite field laboratory to evaluate and direct activities to maximize investigation budget and provide definitive sampling results. This field investigation also included extensive soil, wetland sediment, surface water/sediment sampling, and groundwater sampling, Mr. Kirchner also coordinated all analytical data, and managed electronic database.

U.S. EPA, RAC II, RI, Monitoring Devices, Wall Township, NJ – Field Team Leader. Mr. Kirchner was responsible for the successful implementation of the Project Operations Plan at the site. He coordinated all field activities for the RI/FS including vertical and horizontal plume delineation using Geoprobe and onsite field laboratory to evaluate and direct activities to maximize investigation budget and provide definitive sampling results. This field investigation also included extensive soil sampling, installation of 10 monitoring wells and groundwater sampling, Mr. Kirchner also coordinated all analytical data, managed electronic database and prepared major portions of the RI report.

Massachusetts Military Reserve, Cape Cod, MA; HAZWRAP work assignment – Environmental Scientist. Primarily assigned to sample management between field teams and mobile laboratory performing onsite GC support. Aided with interpretation of GC data and selection of samples for off-site confirmatory analysis. Also filled in with field sampling teams performing Geoprobe, monitoring well, and ground boring sampling as needed.

Field Oversight

As field overseer, Mr. Kirchner is responsible for the PRP sampling team's adherence to site work plans, sampling plans and applicable federal protocols.

U.S. EPA TES5, Oversight at Naval Security Group Activity, Sabana Seca, PR – Environmental Scientist. Reviewed PRP work plan and sampling plan and CDM's Brossman Shortform in order to provide oversight of well installation, and groundwater and soil sampling activities. Also accepted PRP split samples for the EPA Contract Laboratory Program.

EPA ARCS II, Oversight at Mannheim Avenue Dump, Galloway Township, NJ – Environmental Scientist. Reviewed PRP work plan and sampling plan and CDM's Brossman Shortform in order to provide oversight of groundwater sampling activities. Also accepted PRP spit samples the EPA Contract Laboratory Program.

COE, Gasoline Alley, Fort Drum, NY – Field Auditor. Audit of field laboratory in support of field sampling efforts. Laboratory analysis included SW-846 GC method 8020 for BTEX and modified method 8015 for diesel, fuel oil #2 and kerosene. A full evaluation of sample handling, instrumentation, analysis, QA/QC, data interpretation and data reporting procedures was conducted.

NY/NJ Data Center Manager (DCM)

As DCM, Mr. Kirchner is responsible for the creation, staffing and coordination of activities for NY/NJ Data Management Center (DMC). The NY/NJ DMC provides support for all NY/NJ projects contracted under EPA

and USACE. All sample information and data results are uploaded into the database, validated and verified for accuracy. The data is then available for reporting and analysis in support of project goals.

Analytical Services Coordinator (ASC)

As ASC, Mr. Kirchner is responsible for coordinating all sample management activities with project managers and EPA Region II for CDM's ARCS II contracts. These activities include CLP Routine Analytical Services, USEPA DESA laboratory and Sub-contract laboratory scheduling, preparing and reviewing SOW requests, data tracking, initial projections for scheduling, actual sample collection, completion of data validation, processing validated data packages, and preparing quarterly CLP projection reports for EPA Region II.

Mr. Kirchner also provides insight to analytical rational, electronic data management and data interpretation support to CDM's New York, New Jersey and Pennsylvania office project managers and staff as well as ad hoc analytical support as needed to CDM offices outside the northeast region.

Auditor

As laboratory auditor, Mr. Kirchner reviews and evaluates laboratories to assure compliance with specified statements of work, sampling and analysis plans, and applicable state and federal laboratory requirements and methodologies. He has performed these audits under the NYDEC and DOE contracts as well as in support of CDM's subcontract laboratories under USEPA ARCS II contract. Mr. Kirchner received laboratory auditor's training from the U.S. EPA.

IEA Laboratories Inc., Whippany, NJ; Senior Analyst, 1987 - 1992

Mr. Kirchner has worked extensively in environmental laboratories as both an analyst and a laboratory supervisor. As a laboratory analyst, he has been responsible for the proper acquisition of sample data in accordance with the CLP criteria. He has also been responsible for reporting of sample data in accordance with CLP deliverables criteria.

Mr. Kirchner worked as a senior analyst and was responsible for the analysis of environmental samples in strict adherence with state and Federal regulations. He was also responsible for the maintenance and calibration of laboratory instrumentation in the GC/MS and metals analytical laboratories.

As the metals supervisor, Mr. Kirchner was responsible for the reporting of critical information, trained and motivated staff. He was also responsible for procurement of instrumentation and supplies for the metals laboratory.

As Hazardous Materials Manager, Mr. Kirchner took on the additional responsibilities of Waste Manager and Safety Coordinator. In filling these roles, he became familiar with the classification, shipping, and disposal

requirements involved with hazardous waste. He was responsible for all reporting and record-keeping activities with regard to the laboratories' waste handling and disposal. Distribution and maintenance of the MSDS records also fell under this role.

Stockton State College, Pomona, NJ; 1985 - 1987

As a laboratory instructor Mr. Kirchner was responsible for the coordination of teaching assistant, and instruction of students in the use of laboratory instrumentation. Mr. Kirchner was also responsible for the maintenance and calibration of laboratory instrumentation such as GCs, NMR, FT-IRs, HPLCs, UV-VISs and AAs. Worked closely with faculty and staff in the coordination of laboratory instruction and preparation. Responsible for proper adherence to laboratory safety and safe handling and storage of laboratory chemicals.

NJDEPE Division of Water Classification, Leeds Point, NJ; Chemist, 1985 - 1987

As a chemist with the NJ Department of Environmental Protection and Energy, Mr. Kirchner was responsible for the analysis and collection of seawater, shellfish, and sediments to assess nutrient and metals content. As a member of the shellfish classification team, Mr. Kirchner participated in many studies of coastal and estuarian areas of the state. His primary responsibility was to classify shellfish harvesting areas.

Professional Activities

American Chemical Society, ID No. 1786527T

Training

Certified OSHA 1910.210

Hazardous Materials Management for DOT & IATA compliance

Certified Hazardous Materials Manager

Charles J. Myers, CIH, CHMM

Manager, Health & Safety

Education

M.S. - Industrial Hygiene, University of Pittsburgh, 1975

B.S. - Biology, University of Pittsburgh, 1973

Registration

Certified Industrial Hygienist, No. 2675, 1992

Certified Hazardous Materials Manager, No. 619, 1985

Mr. Myers has specific knowledge of health and safety issues with a variety of projects and an extensive background in integrating health and safety programs with environmental remediation project management. Current duties include:

Experience

- Sets guidance policies for all aspects of Health and Safety Programs including oversight of subcontractor health and safety performance.
- Establishes Integrated Safety Management System guidance and policy.
- Establishes criteria for health and safety program with subcontractors.
- Manages decentralized health and safety staff assigned to each site.
- Monitors, audits, and provides oversight of site practices to verify health and safety performance.
- Sets training requirements and coordinates all training activities for compliance with EPA, DOT, and OSHA regulations.

Professional History

Senior Technical Advisor and Health and Safety Officer – Capitol Hill Anthrax Response Team, November 2001 thru April 2002. Mr. Myers served as the senior technical advisor during CDM's involvement with the response to anthrax on Capitol Hill. CDM deployed over 40 personnel from 27 offices to support EPA's effort to verify the efficacy of decontamination efforts associated with the Hart Senate Office Building. This included both the affected areas within the building and the decontamination effort associated with the critical and personal items that were removed from the building.

Experience Highlights

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Project Health and Safety Manager – Support of EPA's efforts Associated with Asbestos Contaminated Vermiculite Associated with the Former Vermiculite Mine in Libby, Montana; March 2000 thru Present. This effort includes developing, implementing, and maintaining programs designed to provide maximum employee and community health and safety protection. The project involves multiple contractors, performing a variety of activities at various locations throughout the Libby, Montana area. .

Corporate Health and Safety Manager – CDM Federal Program Corp., March 1992 thru Present. Directly responsible for the design, implementation, and assessment of all elements of the Health and Safety and

the Injury/Illness Prevention Programs. Oversees all subcontracted field activities to monitor and verify health and safety performance. During this period of employment, more than four million hours have been worked without a project related lost time injury.

Manages 20-member health and safety and health physics staff who provide direct technical support to all field and office activities. Maintains all injury/illness and loss information; issues quarterly reports. Solely responsible for workers compensation, medical surveillance, training administration throughout the corporation's nationwide organization of 20 offices and multiple project sites and provides oversight, audits, and assessments of all CDM Federal and subcontractor activities. Experience includes:

- Managed a team of ten individuals over 10 months on a project at Paducah GDP to characterize a former uranium enrichment complex. The facility characterization plan was developed to identify areas to be decontaminated before decommissioning. Involved ARAR, DQO, sampling strategies, and beneficial re-use and recycling option. Project was completed ahead of schedule and 25% under budget.

- Served as Health and Safety Manager for site investigation activities at Massachusetts Military Reservation under the HAZWRAP contract. Developed, implemented, and performed periodic assessments of a health and safety program for safe performance of monitoring well installation, groundwater sampling, and related activities.

- Implemented an emergency response plan that addressed toxic, explosive, and physical hazards for remedial investigations, design, and remedial action at Fort Drum.

- Instituted company-wide technical training program to ensure that personnel possess knowledge, skills, and abilities to perform assigned tasks safely and developed an orientation program for new employees.

- Created and implemented program to integrate objectives of the Injury/Illness Prevention Program through-out the organization and implemented programs to maximize risk management/loss control objectives.

Director of Environmental Health and Safety – Thermocor Inc., January 1989 thru March 1992. Fully accountable for all environmental, health, and safety activities for more than $200M worth of remedial construction projects. Project work involved numerous union and non-union subcontractors. All projects were performed without a lost-time injury, OSHA citations, or environmental Notices of Violations. This was accomplished through translation of sound injury/illness prevention principles throughout the organization and integration into all procurement and project activities.

Directly interfaced with local, state, and federal regulators and union counterparts.

Specific project work included incineration, decontamination, demolition, above and below ground tank cleanout and closure, and packaging, transport, and disposal of hazardous wastes (solids, liquids, and sludges). Projects performed were in the public and private sectors. Relevant experience includes:

- Developed/managed assessments of site-specific health and safety, QA/QC, and emergency response plans for the on-site incineration of 70K tons of PCB-contaminated soil and debris at Lasalle Electric Utilities Superfund Site for Illinois EPA. This $35M project was 75% self-performed with union labor.

- Served as Health and Safety QA/QC Manager for the decontamination and demolition of V-60 and V-90 buildings at the Naval Facilities Engineering Command, Norfolk, VA. This $30M project involved subcontracts for asbestos abatement, radioactive decontamination, and demolition activities.

- Served as project health and safety and community liaison manager for the dechlorination of more than 40K tons of PCB-contaminated asphalt and debris at Wide Beach, NY. More than 70% of this $27M project was subcontracted to union and non-union contractors.

- Served as H&S Manager on FUSRAP project. Successfully removed seven underground fuel storage tanks at five different sites at the Lewiston, NY, storage facility. All work was self-performed using union labor.

Manager of Environmental Health and Safety – ENSCO Environmental Services, February 1986 thru January 1989. Responsible for all aspects of environmental health and safety programs for this hazardous waste remediation company. Received the Chairman's Safety Award of Excellence for the safe performance of over 1 million hours worked without a lost time accident.

- Designed, implemented, and maintained a health and safety program for the on-site incineration of 30,000 tons of dioxin contaminated soil. Managed a team of 5 individuals who had day-to-day responsibilities for program implementation.

- Served as H&S Manager on two Oak Ridge contracts involving classification, segregation, packaging, transportation and off-site disposal of chemicals associated with numerous analytical laboratories located at the ORNL complex.

- Served as site safety manager for the characterization, repacking, transportation and disposal of more than 5,000 drums of hazardous waste at an abandoned warehouse in Puerto Rico. All remedial efforts were performed with level B respiratory protection.

- Served as a project manager during the demolition of a mercury-contaminated, chlorine manufacturing facility at a paper manufacturing operation.

Manager of Health and Safety Programs – CECOS Environmental Services, March 1982 thru February 1986. Responsible for health and safety of personnel during the performance of remediation projects to ensure compliance with corporate program objectives.

Radiation Safety Officer – General Electric, Schenectady, New York. Ensured compliance of this multi-facility site with all provisions of GE's radioactive materials license issued by NY State. Renegotiated terms and conditions of the license with NY regulators; performed periodic assessments to verify compliance with license conditions; validated calibration of all instrumentation required to support activities covered by the license. During this period a non-destructive test facility was decontaminated, closed, demolished, transported and disposed.

Professional Activities

American Board of Industrial Hygiene
American Society of Safety Engineers

Training

Certified Industrial Hygienist
Certified Hazardous Materials Manager
Certified Hazard Control Manager
Certified Product Safety Manager
Registered Construction Safety Specialist
DOE "Q" Clearance

References

- Pat Gourieux, Director of Program Planning and Integration
  LMER, Paducah Gaseous Diffusion Plant
  761 Veterans Ave.
  Kevil, KY 42053
  (502) 441-5062

- Thomas Andrews, President
  Ciminelli Services Corp.
  170 Cooper Ave., Suite 112
  Tonawanda, NY 14150-6680
  (716) 447-5684 (past President, Thermocor)

- Fred Schwartz, Vice President
  Full Circle, Inc.
  1006 Richard Lane
  Danville, CA 94526

Melinda Olsen

Data Coordinator/Data Tracker/Field Sample Coordination

Education

Associate's Degree, Secretarial/Word Processing Option, Flathead Valley Community College, 1995

Ms. Olsen's responsibilities include assisting in database management for various environmental projects. These projects require management of chemical data from laboratory deliverables to meet internal and client-deliverable report requirements. Ms. Olsen also provides field sample coordination.

CDM, Edison, NJ; Project Support, 1992 – Present

Ms. Olsen has provided database management assistance for several assignments under CDM's contracts with the U.S. Environmental Protection Agency, Region II, and the U.S. Army Corps of Engineers, Kansas City District.

Remedial Investigations and Predesign Investigations, Federal Creosote Site, Manville, NJ - Provided management support for two databases, one for each phase of the Federal Creosote project. First database contained another contractor's data, received directly from EPA's data management office in both electronic and hardcopy format. Additional data came from a second, non-EPA lab. Provided support with the team effort to upload both formats and to incorporate changes from the data validation step. Reported data to EPA organized by residential property address. Produced additional internal reports by property address in support of the risk assessment segment of the project. In the second phase, sampling was conducted by CDM Federal. Continued to receive data from EPA and other labs, uploaded, incorporated data validation changes, QCed and reported by property address.

Experience Highlights

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Remedial Investigation, Horseshoe Road Site, Sayreville, NJ - Provided management support for two databases, one for the RI phase and the residential phase of the project. Uploaded the electronic deliverable and incorporated changes from the data validation step. Reported data to the Project Manager.

Smithtown Groundwater Contamination Site, Smithtown, NY – Provided database management support for the RI phase and the residential phase of the project. Provided human health and ecological risk reports to the Project Manager.

Remedial Investigation/Feasibility Study, Puchack Well Field Site, Pennsauken Township, NJ - Significant team effort supporting database management and reporting.

Predesign Investigations, Rocky Hill Municipal Well Site, Rocky Hill, NJ - Provided data management support with historical data. Provided data management support with residential well samples, private wells, municipal

and monitoring well sampling management. Used the EQuIS Chem and EQuIS Geo programs to manage data.

Remedial Investigation/Feasibility Study, Hiteman Leather Company Site, West Winfield, NY - Provided data management support for this site.

Remedial Investigation/Feasibility Study, Emmell's Septic Landfill Site, Atlantic City, NJ - Provided extensive data management support for this site.

Remedial Investigation/Feasibility Study, Vega Baja Waste Disposal Site, Puerto Rico – Provided extensive data management support for this site.

Remedial Investigation/Feasibility Study, LCP Chemicals Site, Linden, NJ - Provided extensive data management support for this site.

Remedial Investigation/Feasibility Study, Kauffman & Minteer Site, Jobstown, NJ – Provided extensive data management support for this site.

Remedial Investigation/Feasibility Study, Hiteman Leather Company Site, West Winfield, NY - Provided field sample coordination for this site.

Remedial Investigation/Feasibility Study, Emmell's Septic Landfill Site, Atlantic City, NJ – Provided field sample coordination and performed residential groundwater sampling for this site.

Remedial Action, SMS Instruments, Deer Park, NY – Provided field sample coordination for this site.

Training

EQuIS Data Management, 2000

24 Hour Emergency Response Training, June 2002

10-Hour Construction Safety Training, January 2003

Adult CPR Training, March 2003

Jeniffer M. Oxford (McDowell-Oxford)

Environmental Scientist

Education

B.S. - Natural Sciences,
University of the West Indies,
1982 with Honors

Ms. Oxford provides technical support of hazardous waste projects through Quality Assurance (QA), and health and safety coordination, data management, validation of organic & inorganic analytical data, technical reviews of environmental documents, and as project chemist.

Ms. Oxford is responsible for implementing the QA program on RAC II work assignments. She is the health and safety coordinator for the New York and New Jersey offices and provides data management on several projects. Ms. Oxford has provided oversight of subcontractors on data validation, records management, feasibility studies, PRP searches, litigation support, community relations, and risk assessment work assignments. Ms. Oxford also has experience in analytical chemistry, laboratory operations and management, and data validation, specializing in hazardous waste contaminant analysis in support of EPA Superfund contracts. Ms. Oxford has performed assessments of fate and transport phenomena in soil and water.

Experience

As subcontractor coordinator, Ms. Oxford was responsible for financial tracking, monthly status reports and timeliness of project deliverables, as well as coordination and assistance in the review of project deliverables.

Ms. Oxford performed organic and inorganic data validation for the RAC II, BNL and ARCS II EPA Superfund contract in Region II. Data Validation of routine analytical services (RAS) and special analytical services (SAS) analysis for organic compounds includes review and evaluation of the procedures involved with the following: sample holding times; GC/MS tuning; initial and continuing calibration; method blanks; surrogate recovery; matrix spike/matrix spike duplicates; field duplicates and field blanks; internal standards performance; TCL compounds identification; compound quantitation and reported detection limits; system performance; and overall assessment of data quality and useability.

Experience Highlights

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Data validation of RAS & SAS analysis for inorganic compounds includes assessment of the procedures involved with the following; sample holding times; initial, continuing and blank calibration verification; laboratory preparation of field blanks; interference check and laboratory check sample analysis; specific sample results including matrix spike/matrix spike duplicates, GFAA QC analyses including duplicate injections and analytical spikes, ICP QC analysis, and sample result verification; field and other QC; and overall assessment of data quality and useability.

Professional History

CDM Federal Programs Corporation, New York, NY; Environmental Scientist, 1989 – Present

Ms. Oxford has over eleven years of experience in subcontractor management, data validation and technical document reviews. She has provided Health and Safety, QA and data management support in the past five years.

Health and Safety Coordinator. As Health and Safety coordinator, Ms. Oxford prepares and reviews HASPs, coordinates hazardous waste response safety training (40 hour and 8- hour refresher training and fit testing) in compliance with 29 CFR and, performs accident investigations, and maintains a local database of training records for the New York and New Jersey field staff.

All RAC II work assignments-QA Coordinator. As QA coordinator, Ms. Oxford actively tracks the implementation of the quality management plan and consults periodically with site managers to select appropriate quality measures for their work. She interfaces with EPA QA officers and team QA coordinators; trains the technical staff in QA program implementation; maintains an awareness of active work assignments and their quality needs; reviews work and field plans and measurement reports; evaluate technical services solicitations and responses; participates in field planning meeting; conducts or arranges audits or surveillances; initiates and follows up on corrective action requests; provides input for routine trend analysis and MSR, as required; identify opportunities for improvement; requests and distributes lessons learned to staff. She prepares monthly QA activity reports; communicates quality comments from EPA to project staff.

RAC II Contract - Montclair/West Orange and Glen Ridge RI/FS; Emmell Septic Landfill Site; and the Hiteman Leather Site – Data Manager. Responsibilities included project database setup and management and is the primary contact with project managers or task leaders. She is required to understand project objectives, and to provide direction on project needs, ensure progress of project, track budget and alert managers with concerns, verify QC of data, review reports/tables for proper content, and coordinate efforts with project staff.

USACE Kansas City District, Montclair/West Orange/Glen Ridge U.S. Radium Site, NJ - Project Scientist. Coordination of indoor radon level measurements and reporting; preparation and submittal of final data documentation property owner packages to the EPA and U.S. Army Corps of Engineers, Kansas City District; property close-outs, data review of topsoil and soilfill sample results, maintenance of databases for the alpha tracking devices, gamma-survey, gamma radiation exposure levels and soil sample results; monthly reporting on the status of 773 properties in the study areas,

and updates of the color maps for the Glen Ridge, Montclair and West Orange study areas.

Gilette, Asbestos Dump Site, NJ. Ms. Oxford assisted the project manager in the preparation of the Invitation for Bid for analytical Laboratory Services in compliance with the New Jersey Department of Environmental Protection (NJDEP) state requirements for Soil Re-use and Waste Classification.

Jannsen Site, Gurabo, Puerto Rico. Performed document reviews of the Fate and Transport section of the Draft and Revised Remedial Investigation reports.

Ciba-Geigy, Toms River, NJ. Provided community relations support in the form of reporting on the monthly technical meetings at the Ciba-Geigy site. Provided assistance to EPA on the historical site findings summary for presentation to the New Jersey State and Federal representatives.

U.S. DOE, Brookhaven National Laboratory (BNL), RI/FS - Data Manager. Responsible for data tracking from sample collection through data report table preparation. Ensured that data tracking was kept up to date and that the database was revised with validation qualifiers and any other necessary revisions. Coordinated with laboratory as required for troubleshooting or changes in schedule. Prepared the fate and transport chapter for OUI/OUVI RI.

Hudson River, RI/FS Reassessment - Data Validation Task Leader. Coordinate and liaise with diverse team of data validators for the assessment of over 6,000 samples. Scheduling, validation, setting priorities, data tracking and training in new protocols for PCB congeners, total carbon, total nitrogen, total inorganic carbon, weight loss-on-ignition, laser grain size; and CLP parameters, ASTM grain size, chlorophyll-a, % solids. Responsible for project deliverables. Tracking of data on diskettes and data packages as they are received and shipped out for validation. Assisted with procurement of sub-pool contractors and work plan preparation. Monitors data validation task budget. Prepares monthly status reports. Also participated in preparation of bid documents and selection of subpool contractors.

RI/FS, Forest Glen, Glen Falls, NY - Project Chemist. Preparation of assessment of fate and transport of contaminants at the site, useability of the data findings, and the QA/QC controls emplaced for the RI. Coordinated with the subcontract laboratory for resolutions on issues that occurred. Review of project operations plan, laboratory procurement information for bid (IFB), and other project documents. Provide technical assistance in the selection of appropriate methods for quantifying previously tentative identified compounds (TICs).

RCRA Facility Investigation, Hess Oil site. Technical review of PRP data report against work plan for solid waste management units.

HAZWRAP Contracts, BNL, U.S. EPA, TES V and ARCS II Contracts - Data Validation. Ms. Oxford performed data validation on data results for several projects, including Horseshoe Road, Asbestos Dump, Ciba Geigy, G.E. Wiring Devices, MKY Facility, NWS Earle, RCA del Caribe, FMC, Bomarc Missile, Cecos, Chemical Leaman, Curcio, Chemical Waste Management, Davis and Geck, G.E. Waterford, Kin Buc, Mannheim Avenue Dump, Marathon Battery, North Sea Landfill, Ringwood, Robintech, Rollins, Sinclair, SMS Instruments, Swope Oil, Tutu Wellfield, Hudson River and BNL.

Subcontractor Monitor, Records Management, Region II Superfund Sites, NY/NJ. Preparation of work plan and cost estimates. Coordination of project deliverables, QA review of finalized administrative records, monitoring of subcontractor activities - tracking of 2.1 million budget expenditures, reconciliation of site specific charges - comparison of actual tasks performed and those billed, preparation of expenditure and status letters, initiation of conflict of interest (COI) screening and job charge numbers as sites are authorized by client, and general administrative oversight of project. Finalize monthly status reports.

Bridgeport Rental & Oil Services Site, Litigation Support, Logan Township, NJ - Subcontractor Monitor. Ms. Oxford coordinated project tasks, and deliverables for document microfilming and image processing. Preparation of work plans and work authorizations for subcontractor. Prepared expenditure letters and project status letters. Finalize monthly status reports.

RI/FS and Risk Assessment, Subcontractor Monitor for G.E. Wiring Devices Site, Juana Diaz, Puerto Rico; Marathon Battery Site, Cold Spring, New York and Barceloneta Landfill Site, Barceloneta, Puerto Rico. Preparation of work plan and cost estimates, expenditure letters and project status letters. Liaise with client project manager. Coordination of project deliverables - scheduling and planning for technical and QA review of documents, meetings and teleconferences. Monitoring of subcontractor activities - tracking of budget status, reviewed monthly tasks and compared with incurred costs. Assisted with the technical review of comments on PRP field reports, data reports and treatability type documents. Finalize monthly status reports. Participated in teleconference with client and subcontractors.

Responsible Party Searches, Ventron Velsicol Site Bergen County, NJ, and Global Landfill Site, Old Bridge, NJ - Subcontractor Coordinator,. Preparation of work plan, expenditure and project status letters. Liaise with client project manager. Coordination of project deliverables - scheduling and planning for technical review of documents, meetings and teleconferences. Monitoring of subcontractor activities - tracking of budget status, reviewed monthly tasks and compared with incurred costs. Finalize monthly status reports.

Compliance and Enforcement, Gray Iron Foundries, New York and New Jersey - Subcontractor Monitor. Preparation of revised work plan, expenditure letters and project status letters. Liaise with client project manager and coordination of project deliverables (field inspection reports) to ensure schedule adherence and for technical review. Monitoring of subcontractor activities and tracking of budget.

Rosen Site, Cortland, New York; Diamond Alkali Site, New York, New Jersey; North Sea Landfill Site, New York; RCA del Caribe Site, Barceloneta, Puerto Rico; Frontera Creek Site, Humacao, Puerto Rico - Community Relations/Subcontractor Monitor. Preparation of work plan and cost estimates, expenditure letters and project status letters. Liaise with client project manager. Coordination of project deliverables - scheduling and planning for technical and QA review of documents. Coordination of project deliverables - scheduling and planning for technical and QA review of documents. Monitoring of subcontractor activities - tracking of budget status, review of monthly tasks and compared with incurred costs. Assisted with the technical review of project deliverables.

Chemical West Management (CWM), Newark, NJ; Analytical Chemist/Group Leader, 1986 – 1989

As a group leader for CWM, Ms. Oxford supervised four chemists performing laboratory operations to ensure compliance with CWM standards and practices provided sales support and compiled data for daily and monthly reports. Ms. Oxford was responsible for bench scale and non-hazardous treatment of hazardous aqueous and soil waste samples to meet New Jersey Department of Environmental Protection discharge permit requirements, analysis of incoming loads from waste generators, and chemical analyses for organic and inorganic compounds. Treatment methods included detoxification of cyanide wastes through oxidation (chlorination with sodium hypochlorite), metals removal by reduction with sulfide, pH adjustment and filtration, and other non-routine treatments. Types of analyses performed (includes sample preparation, extraction and analysis for the following): Gas Chromatographic (G.C.) Analysis of waste materials (soils and water) for pesticides and PCB's, GC-Mass Spectrophotometric (GC-MS) analysis of various organic compounds, petroleum hydrocarbons, cyanide distillation and analysis (spectrophotometric and titrimetric), ignitability, % solids, pH, titration, specific gravity, hexavalent chromium sulfide, flash point, fluoride, toxicity characteristic leaching procedure (TCLP analysis), other wet methods.

Honig Chemicals, Newark, New Jersey; Laboratory Chemist, 1985 – 1986

Quality control of process products was Ms. Oxford's responsibility at Honig Chemicals. Ms. Oxford performed laboratory procedures such as organic extractions, assays, chemical identifications, and titrations.

Jamaica Bureau of Standards, Kingston, Jamaica, W.I.; Standards Officer, 1982 – 1985

At the Jamaica Bureau of Standards Ms. Oxford responsibilities included research and development of new products to develop standard test procedures; analysis of non-routine industrial and pharmaceutical products utilizing United States Pharmacopeia (USP) and ASTM methods; updating and writing laboratory standard operating procedures; prepared laboratory reports for clients.

Training

40 Hour Training - Hazardous Materials Incident Response Operations

EPA Region II organic data validation,

EPA Region II inorganic data validation,

CDM Federal

QA/QC Training

Powerpoint Fundamentals

Kershu Tan, P.E.

Principal/Senior Environmental Engineer

Mr. Tan serves as a Senior Project Manager at CDM. He has 20 years of experience in the field of environmental engineering with emphasis on hazardous waste site investigation and remediation. His major responsibility is to manage remediation projects and provide technical support for hazardous waste site remediation projects under various contracts. He has directed or participated in all phases of activities under CERCLA which include emergency response, site assessment, removal activities, preliminary assessment, RI/FS, and RD/RA. He also has extensive RCRA experience by working under EPA TES contract. In addition, Mr. Tan has conducted remediation technology research for the EPA UST contract and has performed laboratory research in the area of treatment technologies for contaminated soils.

Education

M.S. – Civil / Environmental Engineering New Jersey Institute of Technology 1989

B.S. – Civil / Hydraulic Engineering Feng Chia University, Taiwan 1985

Registration

Professional Engineer
Connecticut No.19306, 1995
New Jersey No. GE43952, 2002

Experience

Mr. Tan is currently managing the Montclair/West Orange & Glen Ridge Radium Superfund sites, Federal Creosote Superfund Site, Glen Cove Site, and Iceland Coin Superfund Site. He supervises the site daily operations, design investigations, remedial investigation and remedial design. He also provides technical support for EPA and U.S. Army Corps of Engineers, New York District during construction. He has been directly involved in the detailed design for a 1-mgd groundwater pump-and-treat project at the BNL Superfund site. He has prepared 30% and 90% design reports including plans and specifications. He has performed technology screening to identify remediation technologies for the treatment of contaminated soils and buried potential radioactive containers at hazardous waste sites. He also has performed technical document review and field oversight on PRP's remedial design and remedial action projects. Mr. Tan has been involved in several RCRA site technical document review of RFA, RFI, RCRA Closure, and Corrective Measurement reports.

Experience Highlights

- Received an Honor Award from the Chief of Engineers Design and Environmental Awards Program in 2004
- 20 years of experience in managing RI/FS and RD/RA projects
- Managing projects over $10 million dollars for USACE

Kershu Tan was assigned as Project Manager for Federal Creosote design and construction support services to accelerate the achievement of meeting construction goals for the USACE. This phase for the design addressed complex and challenging technical and regulatory issues, which included retaining wall design for deep excavation, dewatering and wastewater treatment design, odor control, dust monitoring, and treatment and disposal requirements. Mr. Tan makes effective use of specialty subcontractors to address shoring issues. He implemented an innovative schedule saving approach by getting construction off to and early start by use of design performance specifications while providing needed construction support services. Mr. Tan is continuing to deliver designs to optimize the construction schedule and the program is ahead of schedule on this number 1 ranked EPA priority site in 2001.

Mr. Tan was resident engineer for the inspection and management of a remedial action involving solidification/stabilization followed by capping. As a field team leader of several sites, Mr. Tan has prepared cost estimate, field schedule, RFP and IFB Statement of Work as well as supervised field staff and subcontractors in various field activities such as soil sampling, groundwater sampling, air sampling, surface water and sediment sampling, soil boring, monitoring well installation, down-hole geophysical logging, packer testing, and wetland delineation.

Mr. Tan as a key project engineer assisted in developing the Weathered Superfund Sludge research project under the UST contract. Mr. Tan performed Superfund weathered sludge data search through the EPA data files and evaluated their physical, chemical, and biological properties in order to assist EPA in developing innovative technologies. Mr. Tan an organizer of the EPA Superfund Weathered Sludge Workshop held in Edison, New Jersey in 1991.

Mr. Tan performed a series of laboratory experiments to research the characteristics and treatment potential of contaminated soils found at various sites in Jersey City, New Jersey. Fundamental soil tests were performed to characterize various types of soil. Experiments were conducted to assess the efficiency of contaminant removal for various technologies including soil washing. These experiments included the determination of maximum adsorption/desorption capacities of chromium ions in several varieties of soil.

Mr. Tan, a member of the Technical Assistance Team for the EPA Region II Removal and Prevention Branch, was directly in charge of removal actions at several hazardous waste sites. His responsibilities included preliminary site evaluation (site assessment), on-site characterization of hazardous waste, and the coordination of hazardous waste removal activities.

CDM, New York, NY; Environmental Engineer, 1990 – Present

Remedial Investigations / Feasibility Studies

Glen Cove Creek, Glen Cove, New York, U.S. Army Corps of Engineers KC District – Project Manager. Managed a Human Helath and Ecological risk assessment is currently preparing a Focus Feasibility Study for the creek remediation.

Iceland Coin Laundry Superfund Site, New Jersey; U.S. EPA Region II – Project Manager - Managing the remedial investigation and feasibility study assignment. Work involved in installation of soil boings and groundwater monitoring wells, collection of soil and groundwater samples, and preparation of a Remedial Investigation and Feasibility Study reprots.

Chemsol Site, Piscataway, New Jersey; U.S. EPA Region II - Project Engineer / Field Team Leader. Involved in work plan preparation; RFP and IFB Statement of Work preparation; preparation of cost estimate and scheduling for field activities; assisting Site Manager to implement and supervise all RI field activities and subcontractors; performed field investigation including collecting two rounds of surface water/sediment

sampling, wetland delineation, collecting two rounds of air sampling by using SUMMA canisters, installing 102 soil borings and collecting more than 200 soil samples for both PCB field screening and laboratory analysis, installation of nine monitoring wells including bedrock coring, downhole geophysical logging, packer testing, and well abandonment. Involved in preparation of the Remedial Investigation report.

Prepared cost estimate for the Feasibility Study Report. Selected remedial alternatives for groundwater which included no action (maintain current pump-and-treat scenario) and increase pumping rate from various wells based on bedrock modeling performed by CDM. Selected remedial alternatives for surface soil including LTTD, solvent extraction, and dehalogenation in conjunction with onsite S/S or offsite landfill.

Ciba-Geigy site, Toms River, New Jersey; U.S. EPA Region II - Project Engineer / Assistant Field Team Leader. Identified contaminated soil areas and their volume, developed and screened soil remediation technologies for more than ten different source areas. Technologies involved physical, chemical and biological treatment by following EPA's guidelines. Provided oversight of PRP test pit installation for buried drum excavation at several drum disposal areas, performed drum characterization and drum sampling for more than 300 drums in level B personal protection.

Kin-Buc Landfill, Edison, New Jersey; U.S. EPA Region II - Environmental Engineer. Performed a feasibility study review to evaluate technologies selected for site remediation and the associated cost estimates. Evaluated landfill cap design using the Hydrologic Evaluation of Landfill Performance (HELP) computer model. Performed sensitivity analysis by using HELP model. Involved in developing additional treatment alternative of pump-and-treat for groundwater remediation.

Remedial Designs / Remedial Actions

Feder al Creosote Superfund Site, Manville, New Jersey, U.S. Army Corps of Engineers – Project Manager.

Montclair / West Orange & Glen Ridge Superfund Sites, Essex County, New Jersey, U.S. Army Corps of Engineers - Site Superintentend /Project Manager. Project Manager of ongoing work. Responsible for scheduling and budgets, manages site daily operations including supervising various subcontractors, manages design investigations and design submittals, provides technical support to USACE and EPA, provides engineering services for USACE-NY District during construction, provides public relations support to EPA. Instrumental in CDM receiving three "Excellent" ACASS ratings for pre-design investigations, designs, and engineering services during construction at these sites. This project has also received the Marini Award for client service.

GCL Superfund Site - Environmental Engineer. Provided oversight of bench-scale low temperature thermal desorption treatability study

performed by a subcontractor for creosote removal. Reviewed treatability study report.

Brookhaven National Laboratory Superfund Site, Upton, New York, U.S. Department of Energy - Environmental Engineer. Designed a 1-mgd groundwater remediation pump-and-treat system including two extraction wells, one air stripping tower with air/water ratio 70:1, an iron sequestering system and chlorination system, and a recharge basin to remove VOC contaminants. Prepared 30% and 90% design packages. Detail design included the evaluation of offgas treatment alternatives and their respective cost estimates.

Brookhaven National Laboratory Superfund Site, Upton, New York, U.S. Department of Energy - Environmental Engineer. Prepared a Preliminary Evaluation of Alternatives Report for the Chemical/Animal/Glass Holes areas. Intact laboratory containers including radioactive chemicals were found buried under these areas. Alternatives for the remediation included no action, capping in conjunction with subsurface barriers, insitu vitrification, manual excavation, robotic excavation, and bulk excavation. A cost estimate for each alternative was also prepared.

Asbestos Dump Site, Meyerseville, New Jersey, U.S. EPA Region II - Resident Engineer. Construction activities involved earth moving, cut and fill, solidification and stabilization of asbestos containing materials followed by capping. Responsibilities included shop drawing review, field inspection, cost estimate preparation for change orders, supervising subcontractors, maintaining the construction schedule, monthly bill review, and site daily inspection and maintenance.

Chemsol Site, Piscataway, New Jersey; U.S. EPA Region II - Environmental Engineer. Performed technical review of PRP's interim remedial design for a groundwater pump-and-treat system including construction of one extraction well, two air stripping towers, a biological treatment system, a GAC unit, an offgas treatment system (catalytic system) and a river discharge system.

Fibers Public Supply Wells Site, Guayama, Puerto Rico; U.S. EPA Region II - Environmental Engineer. Performed technical review of PRP's remedial action work plan including asbestos contaminated soil removal action; performed technical review of PRP's preliminary and pre-final pump-and-treat design plans and specifications for groundwater remediation; attended meetings and conference calls with EPA to assist EPA and local environmental agency in discussion of design and construction issues with PRP and its consultant.

Sinclair Refinery Site, Wellsville, New York; U.S. EPA Region II - Project Engineer. Provided technical support for EPA in reviewing PRP's remedial design and construction including SVE and pump-and-treat system. Provided field oversight in varies phases of field activities.

Upjohn Manufacturing Company, Arecibo, Puerto Rico; U.S. EPA Region II - Environmental Engineer. Provided technical review of remedial design plans and specifications for upgrading an existing groundwater extraction and aeration system.

Mannheim Avenue Site, Galloway Township, New Jersey: U.S. EPA Region II - Environmental Engineer. Provided technical review of PRP's remedial design report including plans and specifications for a pump-and treat system; evaluated the groundwater recharge basin design report.

Cinnaminson Site, New Jersey; U.S. EPA Region II - Environmental Engineer. Povided technical review of PRP's remedial design report including plans and specifications for a groundwater pump-and-treat system.

Pre-Remedial Design Investigations, Expanded Site Investigations (ESI)

Denton Avenue Landfill Site, Town of North Hempstead, New York; U.S. EPA Region II - Project Engineer / Field Team Leader. Prepared drilling subcontract Statement of Work and site specific implementation plan (SSI); supervised subcontractor and field staff in installation of monitoring wells in residential area and installation of soil borings at the inactive landfill.

Regulatory Development, Underground Storage Tank (UST) Program

Superfund Weathered Sludge Project (under BDAT project); U.S. EPA Headquarters and Edison, New Jersey Office - Project Engineer. Conducted data search of physical, chemical, and biological properties for weathered sludge found at Superfund sites; prepared sludge sampling and analysis plan; performed sludge sampling activities at selected Superfund sites; evaluated innovative treatment technologies to assess efficiency in terms of Land Disposal Restriction (LDR) for weathered sludge found at Superfund sites; coordinated with EPA to conduct a Superfund Weathered Sludge Workshop including facility arrangement, identifying speakers in different technical fields; and prepared final project report for EPA's regulatory development.

RCRA Facility Investigation and Corrective Measure Report

Mr. Tan has been involved in activities at several RCRA sites under the EPA TES contract. Activities included technical document review of RCRA Facility Investigation and RCRA Corrective Measurement reports at PPG Puerto Rico site; performed technical review of RCRA Closure Plan which involved a landfill cap design at PROTECO site.

U.S. EPA Region II Technical Assistance Team Contract (ICF Inc. & Foster-Wheeler Enviresponse, Inc.), Edison, New Jersey; Environmental Engineer, 1990

Provided technical support for EPA On-Scene-Coordinator for Superfund site removal action. Responsibilities included conducting site assessment, sampling and field screening, removal and disposal of hazardous waste, on-site monitoring of all phases of removal activities, and preparation of

technical documents. Mr. Tan also conducted onsite HAZCAT to identify/classify hazardous waste materials found at many Superfund sites.

Hazardous Substances Management Research Center, Newark, New Jersey; Research Assistant, 1988 - 1989

Performed fundamental research of clayey soil and conducted laboratory treatability studies of soil washing technology for chromium-contaminated soil found in Jersey City, New Jersey.

Professional Activities

Member - Water Environment Federation

Maria D. Watt, P.E.

Senior Project Manager

Education

B.S., Chemical Engineering, Rutgers University, New Brunswick, New Jersey; 1985

Registration

Professional Engineer, New Jersey, 1994; License No. GE 38847

Ms. Watt has over 19 years of environmental experience. She has extensive experience in managing multi-tasked, multi-disciplined programs requiring interoffice coordination as well as agency negotiation. Her background contains a unique blend of chemical engineering combined with groundwater and surface water hydrology providing exceptional skills for the evaluation of source-pathway-receptor relationships as well as designing and evaluating remediation techniques.

Ms. Watt has been the Program Manager for major contracts for private clients, the United States Environmental Agency (U.S. EPA), United States Army Corps of Engineers (USACE), as well as the Department of Energy (DOE0. These contracts included Hazard Ranking System (HRS) scoring; Remedial Investigation/Feasibility Studies (RI/FSs); Remedial Designs (RDs); and Remedial Actions (RAs). Ms. Watt has managed major Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) contracts within New York and New Jersey during the past fourteen years and serves as a CERCLA/RCRA expert for the northeast region. These programs have values between two and fifteen million dollars.

Experience Highlights

- Professional Engineer in New Jersey
- 18 years experience in CERCLA and HTRW site restoration within USEPA Region II for USACE, USEPA Region 2, and DOE
- 10 years experience in managing multi-million dollar firm fixed price and cost reimbursement government contracts
- Experience managing radiological characterization, treatment and decontamination, modeling and thermal treatment.

As a Program Manager, Ms. Watt has managed and provided technical support to over 50 multi-disciplined professionals. Her experience provides technical insight into negotiations with state and federal regulatory agencies.

Experience

CDM, Edison, New Jersey, Senior Project Manager, August 2004 - Present

U.S. EPA Region II, RI/FS, Emmell's Septic Landfill, Galloway Township, New Jersey – Project Manager. Ms. Watt manages a Focused Feasibility Study (FFS) and RI/FS project at the Emmell's Septic Landfill Site. Within 4 months of assuming the position of project manager, Ms. Watt received an "exceeds expectations" rating from the U.S. EPA for delivering documents of exceptional quality and expediting the project schedule. From 1967 to 1979 the site was used for disposal of septic wastes, sewage sludge, chemical wastes, paint sludge, gas cylinders, household garbage, and construction debris. Groundwater affected by contamination on the site is used for drinking water for local residents and Stockton State College. In 1984, Volatile Organic Chemical (VOC) contamination was found in Site soil and groundwater and in residential wells.

For the FFS, CDM collected field data to support development and screening of remedial alternatives for an interim groundwater remedy to protect

human health. A pump and treat interim groundwater remedy utilizing air stripping is being designed to control groundwater contamination migration in the vicinity of the site. CDM is also responsible for preparing a Data Evaluation Report, Human Health Risk Assessment, and providing Community Relations support.

An RI/FS is being conducted to define the nature and extent of contamination at the Site and to develop a final remedy that is protective of human health and the environment. Field activities have included:

- Cultural resources survey – Phase IA survey to evaluate the potential impact of remedial activities on local cultural resources.

- FFS Field screening – The extent of the ground water plume was determined via field screening. Samples were collected using a direct push method (Geoprobes) and analyzed rapidly by an onsite laboratory. Analytical results from the onsite laboratory guided placement of the next day's Geoprobe samples. A total of 480 samples from 60 screening points, from 2-feet below the groundwater surface and at 10-foot intervals to a total depth of 80 feet below the ground surface were collected.

- RI/FS Field screening – The extent of the ground water plume was determined via field screening. Samples were collected using a direct push method (Geoprobes) and analyzed rapidly by an off-site laboratory using 24 hour turnaround times. Analytical results guided placement of the next day's Geoprobe samples. A total of 9 additional groundwater screening points, installed from 80-feet below the ground surface to 160-feet below the ground surface with groundwater samples collected at 10-foot intervals.

- Monitoring well installation and sampling – Eleven additional monitoring wells and three piezometers and one extraction well were installed in locations selected based on the field screening. A second round of ground water sampling from new and existing monitoring wells and residential wells was completed. Two rounds of ground water sampling utilizing low-flow techniques from the 12 existing monitoring wells and 10 new wells and 4 rounds of 28 residential wells have been completed.

- Aquifer testing – Pump test was performed to collect information regarding aquifer characteristics. Information from the aquifer tests will be used in the groundwater FFS to develop remedial alternatives to protect nearby residential wells from contaminants.

- Subsurface soil borings – Ten soil borings were drilled in and around the source area to define contamination. Soil samples were collected for chemical analysis and to define stratigraphy.

- Surface soil sampling – Surface soil sampling samples were collected at 23 locations to define surface soil contamination in disturbed areas identified in historical aerial photographs.

- A total of 47 Membrane Interface Probe (MIP) borings will be installed in the vicinity of the source area to identify potential Non Aqueous Phase Liquid (NAPL) contamination.

Based upon the results of the MIP investigation, FLUTeJ liners will be installed from the ground surface to a depth of 80 feet bgs using the hollow stem auger drilling method. These liners, coated with a dye that changes color in the presence of NAPL, are installed in an open borehole and left in place to react with NAPL. The liners are recovered by inverting the liner as it is retracted from the borehole. The vertical distribution of NAPL is determined by visual observation of the stained intervals on the liner.

Residential well sampling was expedited to provide concerned residences with sampling results.

A baseline human health and ecological risk assessment will be prepared for the RI/FS to address human health impacts from contaminated surface soil, subsurface soil, and groundwater.

A feasibility study will be prepared to identify general response actions, screen remedial technologies and alternatives and develop a detailed analysis of remedial alternatives to provide a basis for the selection of the ultimate remedy of the site.

U.S. EPA Region II, Targeted Brownfields Assessments for Selected Region 2 Brownfields Initiative Sites– Project Manager. Ms. Watt manages the Targeted Brownfields Assessment (TBA) program that is designed to streamline the characterization and remediation of Brownfield sites to promote redevelopment of abandoned, idled or underutilized industrial or commercial facilities. These activities include: project planning activities; review of background and historical information; performance of Phase 1 and Phase 2 field investigations that utilize innovative technologies and field screening techniques; collection and analysis of environmental samples; data validation, and evaluation; and preparation of site investigation reports summarizing pertinent information, characterizing site contamination, assessing the risk posed to human health and the environment; and screening and evaluating remedial alternatives. Ms. Watt has received an exceeds expectation rating from the U.S. EPA within 4 months of assuming the position of project manager for delivering a high quality Phase 1 Report.

U.S. EPA Region II, Brownfields Technical Support for Multiple Sites in New York and New Jersey – Project Manager. Ms. Watt manages the Brownfields Technical Support program for EPA's Brownfield Pilot Grant Program in EPA Region 2. Ms. Watt tracked relevant Brownfield documents prepared by all of the municipalities and public agencies that have received

EPA Demonstration Pilot Grants. EPA grant money was used to undertake various Brownfield initiatives across the United States. Ms. Watt and the project team prepared fact sheets for widespread public dissemination that summarize the status of each Brownfield site in Region 2, and covers issues that require resolution, and general progress of Brownfield redevelopment. A quarterly newsletter for Region 2 stakeholders that provided information on Region 2 pilots, provided program information, and summarized available resources was also prepared.

U.S. Army Corps of Engineers, Philadelphia District, Vineland Chemical Operable Unit 3, Blackwater Branch Sediment Investigation– Task Manager. Ms. Watt manages the Blackwater Branch Sediment Investigation at the Vineland Chemical Superfund Site in Vineland New Jersey. The Triad Approach was utilized to characterizing arsenic contaminated sediment in the Blackwater Branch. An expedited field program was developed utilizing a 24 turnaround for off-site laboratory analysis to fully characterize the extent of contamination during a single mobilization. An innovative Triad Approach to characterize the contaminated sediment will expedite the achievement of project goals and ultimate remedy of the Vineland Chemical site. Over 265 sediment samples are proposed for complete delineation of the contaminated sediments. Detailed surveying of stream channel will facilitate the evaluation of sediment depositional zones and contaminant migration patterns.

Groundwater & Environmental Services, Wall, New Jersey, Senior Program Manager, May 2002-August 2004

Responsible for marketing and business development for the commercial industrial and government business units. Develop business development and marketing strategy, statement of qualifications, proposals, and marketing materials. Conduct client presentations and sales meetings. Attend and present at conferences, societies and other professional meetings. Direct and manage major projects involving CERCLA, RCRA, voluntary, brownfield and state-led cleanup, Her negotiation skills and her ability to advocate client objectives have led to significant reductions in the duration and costs of projects.

IT Corporation, Edison, New Jersey, Senior Program Manager, March 1988-March 2002

Program Manager for Brookhaven National Laboratory, Department of Energy (approximately $15 million contract). Responsible for the management of major RI/FSs, RDs and RAs. Have received commendations from the client and agencies for expediting and submitting high quality documents. Have also received commendations for negotiating sediment cleanup levels that were two orders of magnitude higher than regulatory standards which resulted in a $100,000,000 savings in remedial costs.

Received a 20% bonus fee for expediting the remediation of 130,000 gallon Imhoff tank that contained approximately 64,000 gallons of radioactive sludge. The radioactive sludge was treated to reduce the overall volume and the residue was shipped to an off-site approved disposal facility.

Program Manager for the Alternative Remedial Contracting Strategy II (ARCS II) program (approximately $5 million contract, 10/88-10/98) as well as the Remedial Action Contract (RAC) program (approximately $2 million contract, 10/98-10/08) for USEPA Region II. Served as Program Manager for ARCS II from 10/88 to 10/98. Due to her excellent performance and her established rapport with regulators in EPA Region 2 and New York State Department of Conservation (NYSDEC), she was positioned as the program manager for the follow-on RAC contract. Managed both contracts with scopes including preliminary assessment/site inspection (PA/SI), HRS, RI/FS, RD, data management, field monitoring, and construction and operation oversight. She has received high performance ratings from EPA Region 2 for expediting an internal removal action and for completing field activities 30 percent under budget. She has received numerous commendations during the course of the program.

Program Manager for the USACE Kansas City HTRW ID/IQ Contract. Managed a $2M cost reimbursable and firm fixed price contract that includes RI/FS/RD and construction and operation oversight. Responsible for technical and administrative oversight of contract management. The project has been performed on schedule and within budget.

Technical Lead for the RCRA Corrective Action for Vance Air Force Base, under the USACE Tulsa TERC Program. Directed a team from five major offices extending from the east coast to Houston. This cost reimbursable project at Vance Air Force Base included the production of a comprehensive high quality RFI/CMS within a record 3-week period and the design, construction and maintenance of a groundwater treatment system. The final RFI/CMS report was approved without any comments. She received commendations from USACE for her exceptional performance. These documents were used by the USACE as templates for future documents of this type.

Project Manager for an incinerator and RCRA storage facility for Occidental Chemical Corporation (OxyChem) for the remediation of the Love Canal Site. Designed and obtained RCRA and environmental impact statement (EIS) permits for an incinerator and storage facility to dispose of the Love Canal waste. An expedited response to meet ACO deadlines resulted in a letter of commendation from the client. A state-of-the-art cumulative impact assessment was negotiated with the New York State Department of Environmental Conservation (NYSDEC) in response to new EPA guidance. Protocols were developed that set precedence for NYSDEC policy.

Project Manager for Standard Motor Products (SMP) State Superfund RI/FS project. Contracted by SMP. to perform a Principal Responsible Party (PRP) RI/FS for a NYSDEC Superfund site in Long Island City, New York. Streamlined the RI/FS process and negotiated less stringent standards for SMP with state agencies

FS/RD Task Manager for the New York State Department of Sanitation (NYSDOS) Fresh Kills Landfill Feasibility Study. A Feasibility Study was performed for the Fresh Kills Landfill leachate mitigation project. The feasibility study integrated continuing landfill activities as well as other continuing programs with remedial alternatives. The feasibility study was streamlined to address the specific concerns of the Administrative Consent Order (ACO).

FS Task Manager/Peer Review for the CERCLA Region III Feasibility study for the Woodland Landfill Superfund site located in Ceal County, Maryland Bridgestone/Firestone Inc. Contracted by Bridgestone/Firestone Inc. to perform a PRP RI/FS. Positioned as FS task manager. Utilized presumptive remedies to expedite the development of the FS.

Technical Manager of Part 360 permit for the Kodak solid waste incinerator located in Rochester, NY. Positioned as the Technical Manager for the management and oversight of the development of an operation and maintenance manual, a contingency plan, a closure plan, and an engineering design document necessary to satisfy requirements of the Part 360 permit application.

Ebasco Services Inc, Lyndhurst, New Jersey, Associate Engineer, January 1987-March 1988

FS Task Manager for the CERCLA Region II RI/FS for the Vineland Chemical Plant Project for the Environmental Protection Agency (EPA) under the REM III contract. Positioned as the Feasibility Task Manager. Responsibilities include: preparation of the Feasibility Study for the Union Lake Area, sampling of sediment and surface water, measuring stream flowrates with a current meter, conducting water quality assessments, modeling and analysis of surface water runoff and sediment transport.

FS Task Manager for the CERCLA Region II RI/FS for the Burnt Fly Bog - Westerly Wetlands Project for the New Jersey Department of Environmental Protection. Responsibilities included: evaluation of remedial technologies and alternatives for PCB and lead contaminations, modeling and analysis of surface water runoff and groundwater flow, development of a total site water balance using the HELP and TR-20 models, preparation of report documents, installation of stream weir and Stevens recorder for flowrate measurements, installation of a MET-ONE weather station, data reduction, development of a "state-of-the-art" water budget for a Superfund site and sampling of sediment and surface water.

Henderson and Bodwell Consulting Engineers, Somerset, New Jersey, Environmental Engineer, March 1986-January 1987

Responsibilities included: computer modeling and hydraulic analysis of surface water runoff, design of hydraulic structures (i.e. detention basins and dams), water quality analyses, earthwork calculations and site plan design for residential and commercial construction projects. Additional responsibilities included the development of storm water management reports for use in site development and flood plain analysis. Methodologies involved the use of various types of software, including HEC II, TR-20, TR-55 and other computer programs used throughout the industry. In addition, responsible for submitting stream encroachment applications for company projects

New Jersey Department of Environmental Protection, Trenton, New Jersey, Environmental Engineer, May 1985-March 1986

Responsibilities included the hydraulic analysis of culverts, bridges, and detention basins for state stream encroachment applications, the interpretation of hydraulic data to determine the flood potential at construction sites. Methodologies used in the flood plain analysis involved the application of various computer programs including HEC II, TR-55 and TR-20. Involved in the preparation and review of technical reports related to stream encroachment

Professional Activities

The Society of American Military Engineers

Chemistry Council of New Jersey

Certifications/Professional Seminars

IT Project Management Associate

OSHA 40-hour Health and Safety Training, Denver Colorado, 1987

OSHA 8-hour Refresher Training, Annually

IT Project Management Training

Publications

N. Luke and M. Watt, 1998, *Data Quality for Ecological Risk Assessment,* presented at the Society of Environmental Toxicology and Chemistry 's 19th Annual Meeting, November 15-19, 1998, Charlotte, North Carolina.

D. Duh, W.H. Medeiros, M. Ali, M. Watt and N. Luke, 1998, *Mercury Contaminated Sediments: Evaluation of Environmental and Human Health Risks,*

presented at the Society of Environmental Toxicology and Chemistry's 19th Annual Meeting, November 15-19, 1998, Charlotte, North Carolina

N. Luke and M. Watt, 1998, *Critical Issues and Importance of Data Quality Management for Remedial Investigation and Feasibility Study*, presented at the Society of Toxicology's 37th Annual Meeting, March 1, 1998, Seattle, Washington

N. Luke, R.S. Prann, B. L. Roberts and M. Watt, 1996, *Role of the Toxicologist in Project Management of a Remedial Investigation and Feasibility Study*. Presented at the Society of Toxicology, 35th Annual Meeting, March 10 -14, 1996, Anaheim, California

M. Watt, N. Luke, and D. Johnson, 1995, *Upfront Approach to Management of a CERCLA RI/FS*. Presented at the IT Symposium, August 17-19, 1995, Scottsdale, Arizona

B. L. Roberts, C.I., R.S. Prann, M. Watt and N. Luke, 1995, *Human Health Risk Assessment of the Sealand Restoration Inc., Superfund*. Presented at the Society of Toxicology, 34th Annual Meeting, February 5-9, 1995, Baltimore, Maryland

R.S. Prann, J. Tasca, A.R. Schnitz, M. Watt, C. Pfrommer and N. Luke, 1995, *Maximum Exposure Individual Screening Procedure for Multiple Emission Sources*, presented at the Society of Toxicology, 34th Annual Meeting, February 5-9, 1995, Baltimore, MD.

A.R. Schnitz, M.D. Watt, R.S. Prann, J.J. Tasca, P.J. Wang and N. Luke, 1992, *The Mattiace Petroleum Chemical Site. Superfund Site: A Human Health Risk Assessment Case Study*. The Toxicologist, page 355.

Field Sampling Plan
APPENDIX B

CDM Technical Standard Operating Procedures (TSOPs)

Sample Custody

Prepared: David O. Johnson

Technical Review: Shelley Thibeault

QA Review: Laura Splichal

Approved: Michael C. Molly 2/24/04
Signature/Date

Issued: 3/10/04
Signature/Date

1.0 Objective

Due to the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Federal Programs Corporation (CDM) files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

Note: Sample custody documentation requirements vary with the specific EPA region or client. This SOP is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements should be presented in the project-specific quality assurance (QA) project plan or project-specific modification or clarification form (see Section U-1).

2.0 Background

2.1 Definitions

Sample – A sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody – A sample is under custody if:

1. It is in your possession
2. It is in your view, after being in your possession
3. It was in your possession and you locked it up
4. It is in a designated secure area

Chain-of-Custody Record – A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal – A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label – A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag – A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes).

3.0 Responsibilities

Sampler – The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader – The field team leader (FTL) is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during the fieldwork and decides if additional samples are required.

Field Sample Custodian – The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

4.0 Required Supplies

- Chain-of-custody records (applicable client or CDM forms)
- Sample labels or tags
- Custody seals
- Clear tape

5.0 Procedures

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations prior to the actual fieldwork. As few people as possible should handle samples.

2. Complete sample labels or tags for each sample using waterproof ink.

3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

Transfer of Custody and Shipment

1. Complete a chain-of-custody record for all samples (see Figure 1 for an example of a chain-of-custody record. Similar forms may be used when requested by the client). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.

    - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the

date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.

- In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.
- If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record.

Note: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher (refer to Figure 1).

2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, samples in the coolers may be recorded on a single chain-of-custody record.

3. The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of-custody record.

Procedure for Completing CDM Example Chain-of-Custody Record
The following procedure is to be used to fill out the CDM chain-of-custody record. The record provided herein (Figure 1) is an example chain-of-custody record. If another type of custody record (i.e., provided by the EPA contract laboratory program or a subcontract laboratory) is used to track the custody of samples, the custody record should be filled out in its entirety.

1. Record project number.
2. Record FTL for the project (if a field sample custodian has been designated, also record this name in the "Remarks" box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier's airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives added to the sample.
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection in military time.

Figure 1
Example CDM Chain-of-Custody Record

CDM

125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-9123
Fax: (212) 785-8114

CHAIN OF CUSTODY RECORD

PROJECT ID.	FIELD TEAM LEADER	LABORATORY AND ADDRESS	DATE SHIPPED
PROJECT NAME/LOCATION		LAB CONTRACT:	AIRBILL NO.

MEDIA TYPE
1. Surface Water
2. Groundwater
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil
7. Waste
8. Other _____

PRESERVATIVES
1. HCl, pH <2
2. HNO_3, pH <2
3. NaOH, pH >12
4. H_2SO_4, pH <2
5. Zinc Acetate, pH >9
6. Ice Only
7. Not Preserved
8. Other _____

SAMPLE TYPE
G = Grab
C = Composite

SAMPLE LOCATION NO.	LABORATORY SAMPLE NUMBER	PRESERVATIVES ADDED	MEDIA TYPE	SAMPLE TYPE	20__ DATE	TIME SAMPLED	ANALYSES (List no. of containers submitted)								REMARKS (Note if MS/MSD)
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

SAMPLER SIGNATURES:

RELINQUISHED BY: (Print) (Sign)	DATE/TIME	RECEIVED BY: (Print) (Sign)	DATE/TIME	RELINQUISHED BY: (Print) (Sign)	DATE/TIME	RECEIVED BY: (Print) (Sign)	DATE/TIME
RELINQUISHED BY: (Print) (Sign)	DATE/TIME	RECEIVED BY: (Print) (Sign)	DATE/TIME	RELINQUISHED BY: (Print) (Sign)	DATE/TIME	RECEIVED BY: (Print) (Sign)	DATE/TIME

COMMENTS:

DISTRIBUTION: White and yellow copies accompany sample shipment to laboratory; yellow copy retained by laboratory. Pink copy retained by samplers. 1/98

Note: If requested by the client, different chain-of-custody records may be used. Copies of the template for this record may be obtained from the Chantilly Graphics Department.

13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter matrix spike/matrix spike duplicate (MS/MSD) if sample is for **laboratory** quality control or other remarks (e.g., sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the "Remarks" column.
18. The originator checks information entered in Items 1 through 16 and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time (military).
19. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.
20. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under "Remarks" on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the copy. The white copy is returned to CDM.

5.2 Sample Labels and Tags

Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted for CDM projects.

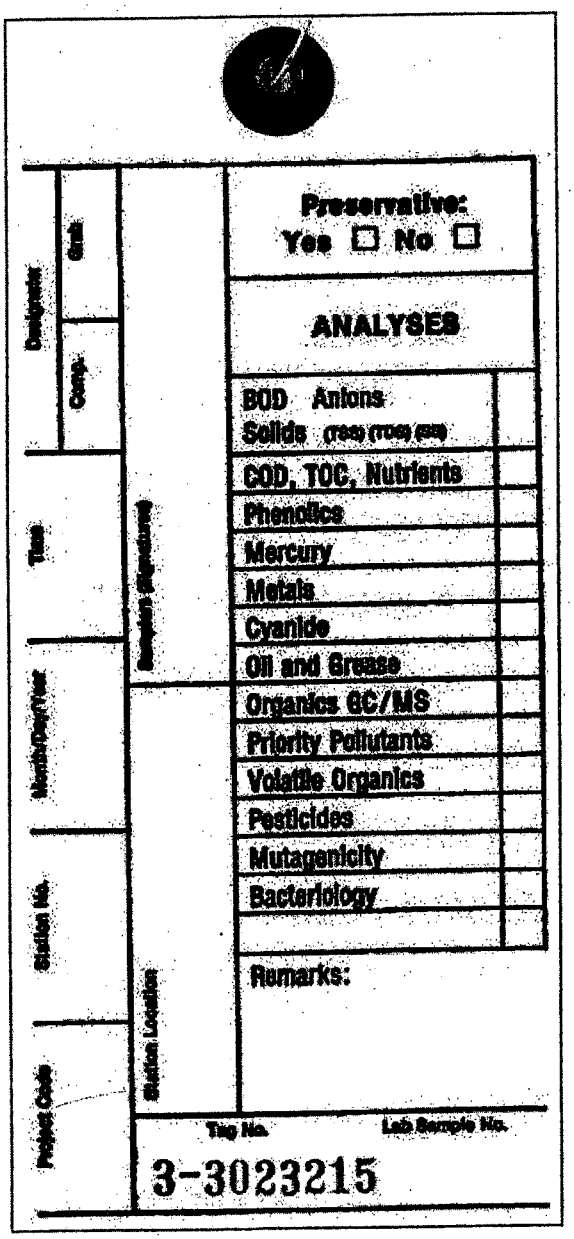
1. Complete one label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows (see Figure 2 for example of sample tag; labels are completed with the equivalent information):

   - Record the project code (i.e., project or task number).
   - Enter the station number (sample number) if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.
   - Place a check to indicate composite or grab sample.
   - Record the station (sample) location.
   - Sign in the space provided.
   - Place a check next to "yes" or "no" to indicate if a preservative was added.
   - Place a check under "Analyses" next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. **Note:** Do not write in the box for "laboratory sample number."
   - Place or write additional relevant information under "Remarks."

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.

3. Securely attach sample tags to the sample bottle. On 2.27 liter (80 oz.) amber bottles, the tag string may be looped through the ring style handle and tied. On all other containers, it is

Figure 2
Example Sample Tag



Note: Equivalent sample labels or tags may be used.

recommended that the string be looped around the neck of the bottle, then twisted and re-looped around the neck until the slack in the string is removed.

4. Double-check that the information recorded on the sample tag is consistent with the information recorded on the chain-of-custody record.

5.3 Custody Seals

Two custody seals must be placed on opposite corners of all shipping containers (e.g., cooler) prior to shipment. The seals should be signed and dated by the shipper.

Custody seals may also be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction.

5.4 Sample Shipping

The CDM standard operating procedure listed below defines the requirements for packaging and shipping environmental samples.

- CDM Federal SOP 2-1, Packaging and Shipping Environmental Samples

6.0 Restrictions/Limitations

Check with the EPA region or client for specific guidelines. If no specific guidelines are identified, this procedure should be followed.

For EPA Contract Laboratory Program (CLP) sampling events, combined chain-of-custody/traffic report forms or other EPA-specific records may be used. Refer to regional guidelines for completing these forms.

The EPA FORMS II Lite™ software may be used to customize sample labels and custody records when directed by the client or the CDM project manager.

7.0 References

U.S. Environmental Protection Agency, *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, EPA/600/R-98/018, February 1998, Section B3.

U.S. Environmental Protection Agency, *National Enforcement Investigations Center, Multi-Media Investigation Manual*, EPA-330/9-89-003-R, Revised March 1992, p.85.

U.S. Environmental Protection Agency, *Contract Laboratory Program (CLP), Guidance for Field Samplers*, EPA-540-R-00-003, Draft Final, June 2001, Section 3.2.

U.S. Environmental Protection Agency, *FORMS II Lite™ User's Guide*, March 2001.

U.S. Environmental Protection Agency, Region IV, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, May 1996, Section 3.3.

U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plan*, EM 200-1-3, February 2001, Appendix F.

Packaging and Shipping Environmental Samples

SOP: 2-1
Revision: 2
Date: March 1, 2004

Prepared: Krista Lippoldt
Technical Review: Chuck Myers
QA Review: Douglas J. Updike
Approved: Michael C. Molloy 2/24/04
Signature/Date
Issued: 2/18/04
Signature/Date

1.0 Packaging and Shipping of All Samples

This standard operating procedure (SOP) applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0 – Packaging and Shipping Samples Preserved with Methanol
Section 3.0 – Packaging and Shipping Samples Preserved with Sodium Hydroxide
Section 4.0 – Packaging and Shipping Samples Preserved with Hydrochloric Acid
Section 5.0 – Packaging and Shipping Samples Preserved with Nitric Acid
Section 6.0 – Packaging and Shipping Samples Preserved with Sulfuric Acid
Section 7.0 – Packaging and Shipping Limited-Quantity Radioactive Samples

1.1 Objective

The objective of this SOP is to outline the requirements for the packaging and shipment of environmental samples. Additionally, Sections 2.0 through 7.0 outline requirements for the packaging and shipping of regulated environmental samples under the Department of Transportation (DOT) Hazardous Materials Regulations, the International Air Transportation Association (IATA), and International Civil Aviation Organization (ICAO) Dangerous Goods Regulations for shipment by air and applies only to domestic shipments. This SOP does not cover the requirements for packaging and shipment of equipment (including data loggers and self-contained breathing apparatus [SCBAs] or bulk chemicals that are regulated under the DOT, IATA, and ICAO.

1.2 Background

1.2.1 Definitions

Environmental Sample - An aliquot of air, water, plant material, sediment, or soil that represents the contaminant levels on a site. Samples of potential contaminant sources, like tanks, lagoons, or non-aqueous phase liquids are normally not "environmental" for this purpose. This procedure applies only to environmental samples that contain less than reportable quantities for any foreseeable hazardous constituents according to DOT regulations promulgated in 49 CFR - Part 172.101 Appendix A.

Custody Seal – A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the container (i.e., cooler) before offsite shipment. Custody seals are used to demonstrate that sample integrity has not been compromised during transportation from the field to the analytical laboratory.

Inside Container – The container, normally made of glass or plastic, that actually contacts the shipped material. Its purpose is to keep the sample from mixing with the ambient environment.

Outside Container – The container, normally made of metal or plastic, that the transporter contacts. Its purpose is to protect the inside container.

Secondary Containment – The outside container provides secondary containment if the inside container breaks (i.e., plastic overpackaging if liquid sample is collected in glass).

Excepted Quantity – Excepted quantities are limits to the mass or volume of a hazardous material in the inside and outside containers below which DOT, IATA, ICAO regulations do not apply. The excepted quantity limits are very low. Most regulated shipments will be made under limited quantity.

Limited Quantity – Limited quantity is the maximum amount of a hazardous material below which there are specific labeling or packaging exceptions.

Performance Testing – Performance testing is the required testing of outer packaging. These tests include drop and stacking tests.

Qualified Shipper – A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Discussion

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis. These shipments are potentially subject to regulations published by DOT, IATA, or ICAO. Failure to abide by these rules places both CDM and the individual employee at risk of serious fines. The analytical holding times for the samples must not be exceeded. The samples should be packed in time to be shipped for overnight delivery. Make arrangements with the laboratory before sending samples for weekend delivery.

1.2.3 Associated Procedure

- CDM Federal SOP 1-2, Sample Custody

1.3 Required Equipment

- Coolers with return address of the appropriate CDM office
- Heavy-duty plastic garbage bags
- Plastic zip-type bags, small and large
- Clear tape
- Nylon reinforced strapping tape
- Duct tape
- Vermiculite (or an equivalent nonflammable material that is inert and absorbent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or contract laboratory program (CLP) custody records, if applicable
- Completed bill of lading
- "This End Up" and directional arrow labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.4 Packaging Environmental Samples

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of "environmental sample" and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager should be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy-duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite or equivalent. **Note**: Trip blanks must be included in coolers containing VOA samples.

5. Place 2 to 4 inches of vermiculite (or equivalent) into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler should reflect only those samples within the cooler.

7. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° Celsius (C) if the analytical method requires cooling. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Place the completed chain-of-custody record or the CLP traffic report form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the opening of the cooler on opposite sides. The custody seals should be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked **"THIS END UP"** and arrow labels that indicate the proper upward position of the container should be affixed to the cooler. A label containing the name and address of the shipper (CDM) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

2.0 Packaging and Shipping Samples Preserved with Methanol

2.1 Containers

- The maximum volume of methanol in a sample container is limited to 30 ml.
- The sample container must not be full of methanol.

2.2 Responsibility

It is the responsibility of the qualified shipper to:

- Ensure that the samples undergoing shipment contain no other contaminant that meets the definition of "hazardous material" as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

2.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packing may consist of glass or plastic jars
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 3 flammable liquid labels
- Orientation labels
- Consignor/consignee labels

2.4 Packaging Samples Preserved with Methanol

The following steps are to be followed when packaging limited-quantity sample shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.

- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
- Total volume of methanol per shipping container must not exceed 500 ml.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

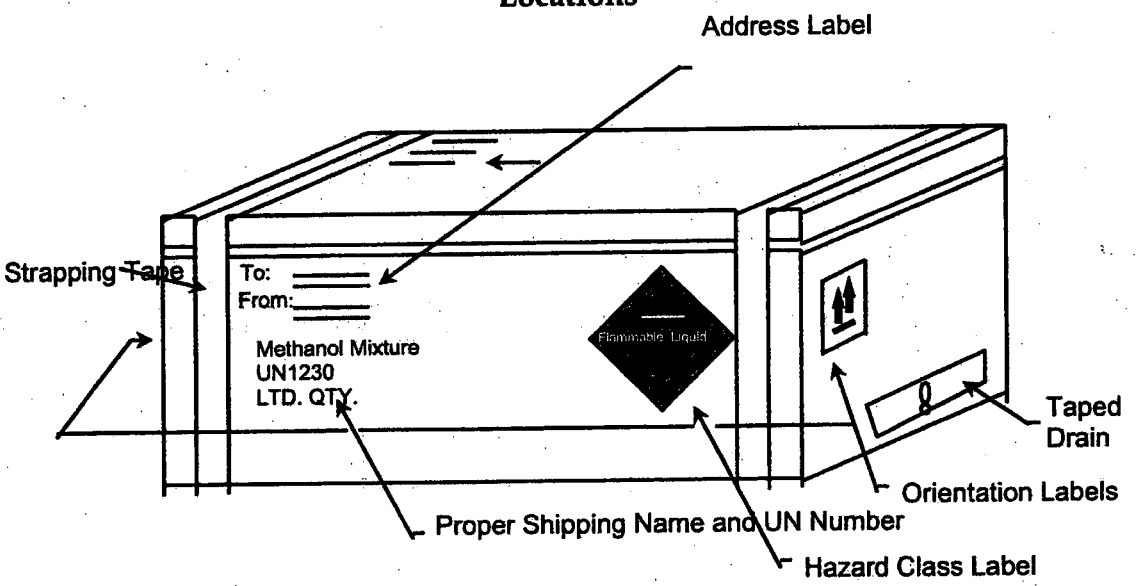
  Methanol Mixture
  UN1230
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Flammable Liquid label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: No marking or labeling can be obscured by strapping or duct tape.
Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

Figure 1 - Example of Cooler Label/Marking Locations



3.0 Packaging and Shipping Samples Preserved with Sodium Hydroxide

3.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sodium Hydroxide Preservatives

		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
NaOH	30%	>12	0.08%		.25	0.5	1	2

5 drops = 1 ml

3.2 Responsibility

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

3.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Inner packings may consist of glass or plastic jars no larger than 1 pint
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

3.4 Packaging Samples Preserved with Sodium Hydroxide

Samples containing NaOH as a preservative that exceed the excepted concentration of 0.08 percent (2 ml of a 30 percent NaOH solution per liter) may be shipped as a limited quantity per packing instruction Y819 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- The total volume of sample in each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

Sodium Hydroxide Solution
UN1824
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples meeting the exception concentration of 0.08 percent NaOH by weight may be shipped as non-regulated or non-hazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

4.0 Packaging and Shipping Samples Preserved with Hydrochloric Acid

4.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Hydrochloric Acid Preservatives

		pH	Conc.	40 ml	125 ml	250 ml
HCl	2N	<1.96	0.04%	.2	.5	1

5 drops = 1 ml

4.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

4.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packing may consist of glass or plastic jars no larger than 1 pint.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

4.4 Packaging Samples Preserved with Hydrochloric Acid

The following steps are to be followed when packaging limited-quantity sample shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (No more than 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)

- Total volume of sample inside each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Hydrochloric Acid Solution
  UN1789
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

  Note: Samples containing less than the exception concentration of 0.04 percent HCl by weight will be shipped as non-regulated or non-hazardous following the procedure in Section 1.4.

  Note: No marking or labeling can be obscured by strapping or duct tape.

  Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

5.0 Packaging and Shipping Samples Preserved with Nitric Acid

5.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Nitric Acid Preservatives

		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
HNO_3	6N	<1.62	0.15%		2	4	5	8

5 drops = 1 ml

5.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

5.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

5.4 Packaging Samples Preserved with Nitric Acid

Samples containing HNO_3 as a preservative that exceed the excepted concentration of 0.15 percent HNO_3 will be shipped as a limited quantity per packing instruction Y807 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity sample shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name

  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

Nitric Acid Solution (with less than 20 percent)
UN2031
Ltd. Qty.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples meeting the exception concentration of 0.15 percent HNO_3 by weight will be shipped as non-regulated or non-hazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

6.0 Packaging and Shipping Samples Preserved with Sulfuric Acid

6.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sulfuric Acid Preservatives

		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
H_2SO_4	37N	<1.15	0.35%	.1	.25	0.5	1	2

5 drops = 1 ml

6.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

6.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

6.4 Packaging of Samples Preserved with Sulfuric Acid

Samples containing H_2SO_4 as a preservative that exceed the excepted concentration of 0.35 percent will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each glass container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

Sulfuric Acid Solution
UN2796
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples containing less than the exception concentration of 0.35 percent H_2SO_4 by weight will be shipped as non-regulated or non-hazardous in accordance with the procedure described in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

7.0 Packaging and Shipping Limited-Quantity Radioactive Samples

7.1 Containers

The inner packaging containers that may be used for these shipments include:

- Any size sample container

7.2 Description/Responsibilities

- The qualified shipper will determine that the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.
- The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, *Limited Quantities of Radioactive Materials.*
- The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided in 173.410. These standards state that a package must be capable of withstanding the effects of any acceleration, vibration, or vibration resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various

receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use.

- If the shipment is from a DOE facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.
- The total activity for each package will not exceed the relevant limits listed in Table 7 of 49 CFR 173.425. The A_2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A_2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.
- The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 mSv/hour (0.5 mrem/hour). These will be verified by dose and activity monitoring prior to shipment of the package.
- The removable radioactive surface contamination on the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a). CDM will apply the DOE-established free release criteria for removable surface contamination of less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma). It should be noted that these values are more conservative than the DOT requirements for removable surface contamination.
- The qualified shipper will verify that the outside of the inner packaging is marked "Radioactive."
- The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**

7.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- Excepted quantities label
- Consignor/consignee labels

7.4 Packaging of Limited-Quantity Radioactive Samples

The following steps are to be followed when packaging limited-quantity sample shipments.

- The cooler is to be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number

- Date and time of sample collection
- Sample location
- Sample identification number
- Collector's initials

- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place sufficient amount of vermiculite, or approved packaging material, in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- If required, place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- Place a label marked Radioactive on the outside of the sealed bag.
- Enclose a notice that includes the name of the consignor or consignee and the following statement: **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**
- Note that both DOT and IATA apply different limits to the quantity in the inside packing and in the outside packing.
- The maximum weight of the package shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- If a cooler is used, wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler/package.
- Affix a completed Excepted Quantities label to the side of the cooler/package.
- Secure any marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of the cooler labeling/marking is shown in Figure 2.

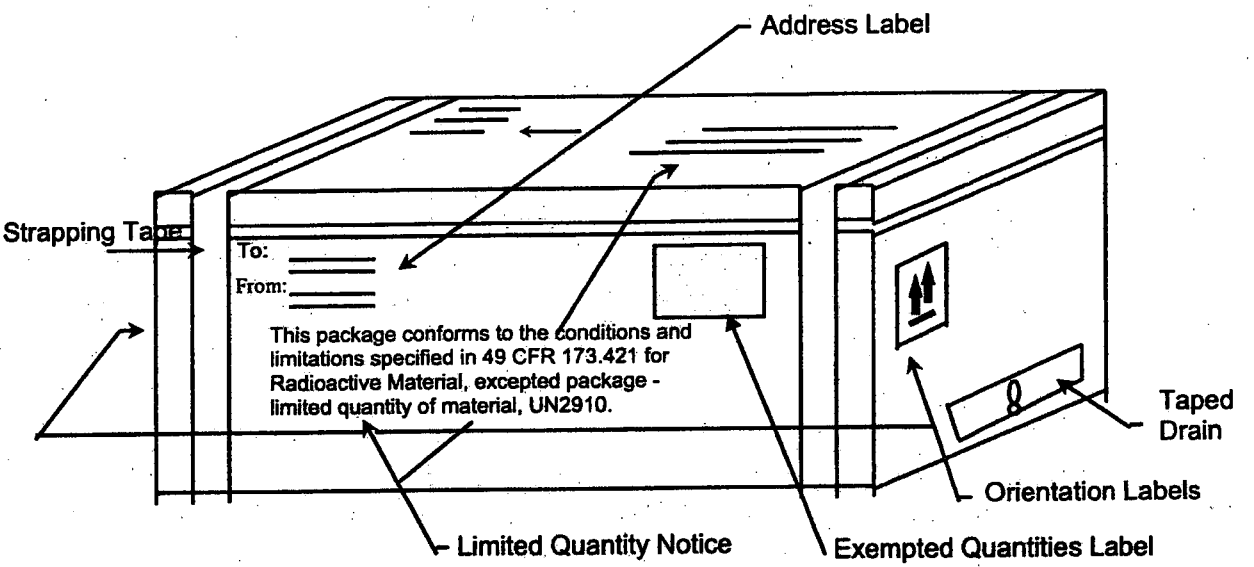
Note: No marking or labeling can be obscured by strapping or duct tape.

- Complete the Shipment Quality Assurance Checklist (Appendix B).

Note: Except as provided in 49 CFR 173.426, the package will not contain more than 15 grams of ^{235}U.

Note: A declaration of dangerous goods is not required.

Figure 2 - Radioactive Material – Limited-Quantity Cooler Marking Example



8.0 References

U.S. Environmental Protection Agency, *Sampler's Guide to the Contract Laboratory Program*, EPA/540/P-90/006, December 1990.

U.S. Environmental Protection Agency, Region IV, *Standard Operating Procedures and Quality Assurance Manual*, February 1991.

U.S. Environmental Protection Agency Rule, 40 CFR 136.

Appendix A

Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity

Sample Packaging

Yes	No	N/A	
❑	❑	❑	The VOA vials are wrapped in bubble wrap and placed inside a zip-type bag.
❑	❑	❑	The VOA vials are placed into a polyethylene bottle, filled with vermiculite, and tightly sealed.
❑	❑	❑	The drain plug is taped inside and outside to ensure control of interior contents.
❑	❑	❑	The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4°C.
❑	❑	❑	The cooler weighs less than the 66-pound limit for limited-quantity shipment.
❑	❑	❑	The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
❑	❑	❑	The chain-of-custody has been secured to the interior of the cooler lid.
❑	❑	❑	The cooler lid and sides have been taped to ensure a seal.
❑	❑	❑	The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes	No	N/A	
❑	❑	❑	Section 1 has the shipper's name, company, and address; the account number, date, internal billing reference number; and the telephone number where the shipper can be reached.
❑	❑	❑	Section 2 has the recipient's name and company along with a telephone number where they can be reached.
❑	❑	❑	Section 3 has the **Bill Sender** box checked.
❑	❑	❑	Section 4 has the **Standard Overnight** box checked.
❑	❑	❑	Section 5 has the **Deliver Weekday** box checked.
❑	❑	❑	Section 6 has the number of packages and their weights filled out. Was the total of all packages and their weights figured up and added at the bottom of Section 6?
❑	❑	❑	Under the **Transport Details** box, the **Cargo Aircraft Only** box is obliterated, leaving only the **Passenger and Cargo Aircraft** box.
❑	❑	❑	Under the **Shipment Type**, the **Radioactive** box is obliterated, leaving only the **Non-Radioactive** box.
❑	❑	❑	Under the **Nature and Quantity of Dangerous Goods** box, the **Proper Shipping Name, Class or Division, UN or ID No., Packing Group, Subsidiary Risk, Quantity and Type of Packing, Packing Instructions, and Authorization** have been filled out for the type of chemical being sent.
❑	❑	❑	The **Name, Place and Date, Signature, and Emergency Telephone Number** appears at the bottom of the FedEx Airbill.
❑	❑	❑	The statement "In accordance with IATA/ICAO" appears in the **Additional Handling Information** box.
❑	❑	❑	The **Emergency Contact Information** at the bottom of the FedEx Airbill is truly someone who can respond any time of the day or night.

Hydrochloric Acid Solution	8	UN1789	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Nitric Acid Solution (with less than 20%)	8	UN2031	II		1 plastic box × 0.5 L	Y807	Ltd. Qty.
Sodium Hydroxide Solution	8	UN1824	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Sulfuric Acid Solution	8	UN2796	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Methanol	3	UN1230	II		1 plastic box × 1 L	Y305	Ltd. Qty.

Sample Cooler Labeling

Yes	No	N/A	
❑	❑	❑	The proper shipping name, UN number, and Ltd. Qty. appears on the shipping container.
❑	❑	❑	The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
❑	❑	❑	The name and address of the shipper and receiver appear on the top and side of the shipping container.
❑	❑	❑	The air waybill is attached to the top of the shipping container.
❑	❑	❑	**Up Arrows** have been attached to opposite sides of the shipping container.
❑	❑	❑	Packaging tape does not obscure markings or labeling.

Appendix B

Shipment Quality Assurance Checklist

Date: _____ Shipper: _____ Destination: _____

Item(s) Description: _____

Radionuclide(s): _____

Radiological Survey Results: surface _____mrem/hr 1 meter _____

Instrument Used: Mfgr: _____ Model: _____

S/N: _____ Cal Date: _____

Limited-Quantity or Instrument and Article

Yes	No		
___	___	1.	Strong tight package (package that will not leak material during conditions normally incidental to transportation).
___	___	2.	Radiation levels at any point on the external surface of package less than or equal to 0.5 mrem/hr.
___	___	3.	Removable surface contamination less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma).
___	___	4.	Outside inner package bears the marking "Radioactive."
___	___	5.	Package contains less than 15 grams of ^{235}U (check yes if ^{235}U not present).
___	___	6.	Notice enclosed in or on the package that includes the consignor or consignee and the statement, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**
___	___	7.	Activity less than that specified in 49 CFR 173.425. Permissible package limit: Package Quantity:
___	___	8.	On all air shipments, the statement **Radioactive Material, excepted package-limited quantity of material** shall be noted on the air waybill.

Qualified Shipper: _____ Signature: _____

Geoprobe® Sampling

Prepared: Kent Hankinson
Technical Review: Sharon Budney
QA Review: Doug Updike
Approved: Michael C. Molloy 2/24/04
Signature/Date
Issued: 3/10/04
Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to define the requirements for collecting soil, soil gas, and groundwater samples using the Geoprobe® sampling system. Geoprobe is a trade name proprietary to Geoprobe Systems of Salina, Kansas.

2.0 Background

2.1 Discussion

The Geoprobe unit consists of a hydraulically operated hammer device mounted in the back of a van or pickup truck (Figure 1). The Geoprobe system hydraulically advances small-diameter, hollow rods to the desired sampling depth. The specific type of Geoprobe sampling equipment for soil, soil gas, and groundwater collection is then employed.

The use of Geoprobe technology may be a cost-effective alternative to using conventional drilling techniques for collecting subsurface soil, soil gas, and groundwater samples depending on the site-specific geologic and hydrogeologic conditions and sample requirements. The Geoprobe system is generally used to gather screening-level data. The site-specific sampling plans must consider such factors as soil types, presence of cobbles, depth to groundwater, quantity and depth of samples, site access and topography, data quality objectives (DQOs), analytical requirements, and waste handling and disposal requirements prior to selecting the use of the Geoprobe.

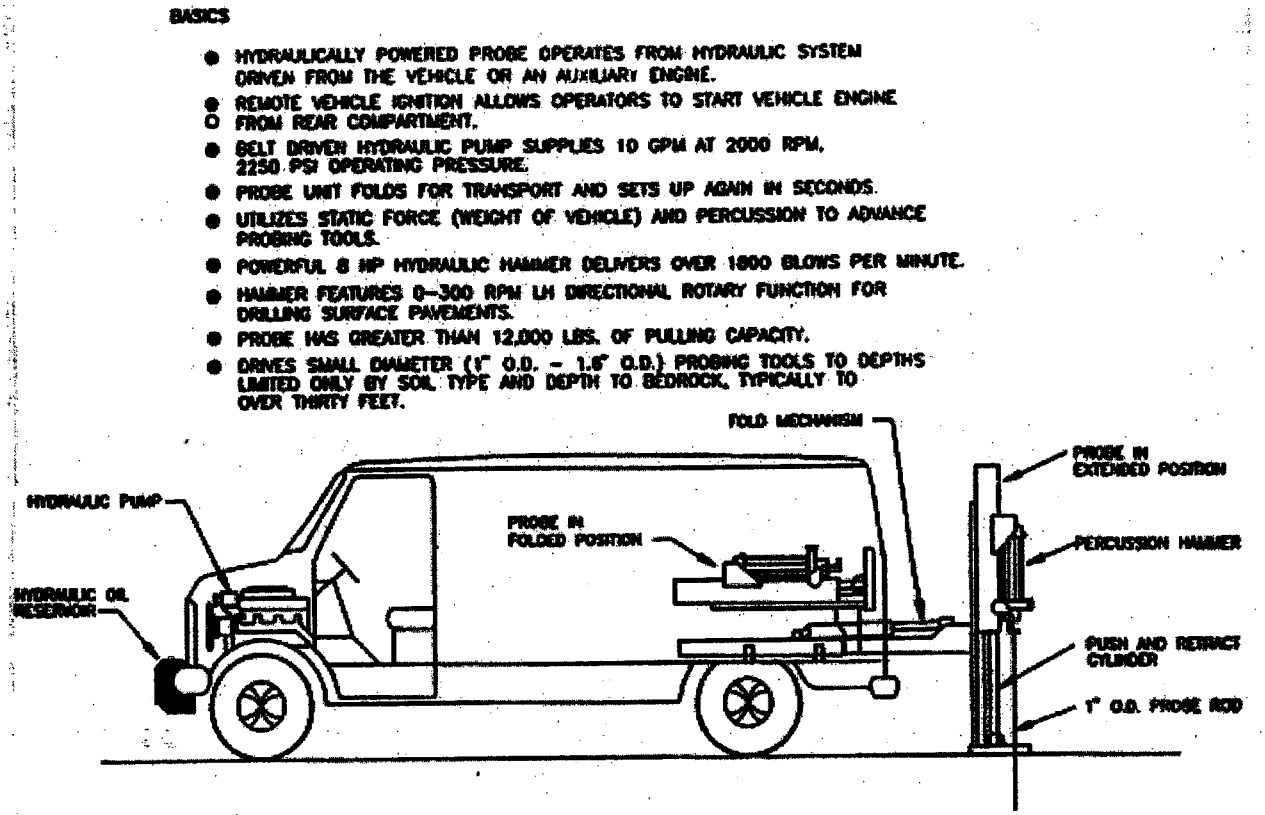
Advantages of using the Geoprobe include:

- Areas usually considered inaccessible by drill rigs because of overhead wires, steep slopes, size constraints, etc., may be accessed with the pickup truck or van-mounted Geoprobe.
- Investigation-derived wastes such as soil cuttings and purge water are minimized with the Geoprobe due to its small diameter rods and because it displaces soil horizontally, not vertically.

Cost savings over conventional drilling techniques may be realized. The Geoprobe is rented/leased on a weekly or monthly basis or purchased for a fixed price as opposed to drilling subcontractors who are generally compensated based on the footage drilled; the Geoprobe may be operated by field personnel rather than subcontractors. A cost evaluation based on project-specific requirements and site conditions should be conducted to determine the most cost-effective method for a particular project.

Two people are required to operate the Geoprobe and conduct sampling and recordkeeping activities. Safety considerations should be addressed when operating the Geoprobe. A safety hazard is present whenever the Geoprobe is operated. The hydraulic system operates with a fluid pressure of over 907 kilograms (kg) (2,000 pounds per square inch [psi]). A leaking hose may produce a stream of hydraulic

Figure 1
Geoprobe Unit



fluid with sufficient pressure to penetrate skin. Therefore, periodic checks of the hydraulic lines and hoses should be conducted to ensure they are in good condition and connections are tight. Do not attempt to repair or tighten hoses with the engine running and the system under pressure. Use paper or cardboard to check for leaks.

2.2 Definitions

Geoprobe - A hydraulically operated hammer device installed in the back of a van or pickup truck, used to advance a hollow-stem rod into the soil for the purpose of collecting soil, soil gas, or groundwater samples.

Probe-Drive Sampler - A sampling device, similar to a split-spoon sampler, used to collect soil samples with a Geoprobe rig. Three types of soil samplers are available: standard 25- and 60-cm (in 10- and 24-inch lengths), large bore (with an acetate liner), and Kansas stainless sampler.

Extension Rod - Stainless steel rod used to remove stop-pin and drive-point assembly.

Extension Rod Coupler - Stainless steel connector used to join sections of extension rods.

Drive Point - Solid steel retractable point used to advance sample collection device to the required sample depth.

Probe Rod - Hollow, flush-threaded, steel rod similar to a drill rod.

Stop-Pin - Steel plug that threads into the top of the drive cap to hold the drive point in place during advancement of the probe rods.

Drive Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when advancing the probe rods with the hydraulic hammer.

Pull Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when retracting the probe rods.

Extruder Rack and Piston - A device used in conjunction with the Geoprobe to force soil sample volume out of the sample tube.

Screen Point Groundwater Sampler - A groundwater sampling device designed for use with the Geoprobe consisting of a well screen encased in a perforated stainless steel sleeve.

Mill-slotted Well Rod and Point - A groundwater sampling device designed for use with the Geoprobe consisting of a Geoprobe probe rod with 15-mil slots, each 5 cm long by 0.05 cm wide (2 inches long x 0.020 inches wide).

Post-Run Tubing System (PRT) - The Geoprobe soil vapor sampling system uses disposable poly-ethylene or Teflon tubing (inserted into the probe rods at the desired sampling depth) and a vacuum.

Expendable Drive Point - Solid steel point attached to the end of the screen point groundwater sampler and PRT expendable point holder.

2.3 Associated Procedures

- CDM Federal SOP 1-2, Sample Custody
- CDM Federal SOP 1-5, Groundwater Sampling Using a Bailer
- CDM Federal SOP 1-6, Water Level Measurements
- CDM Federal SOP 2-1, Packaging and Shipping Environmental Samples
- CDM Federal SOP 4-1, Field Logbook Content and Control
- CDM Federal SOP 4-3, Well Development and Purging
- CDM Federal SOP 4-5, Field Equipment Decontamination

3.0 Responsibilities

Field Team Leader (FTL) - The field team leader (FTL) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure, associated SOPs, and the site-specific plans.

Sampling Personnel - Field team members are responsible for conducting Geoprobe sampling events in accordance with this procedure, all associated SOPs, and requirements as described in the site-specific plans.

4.0 Required Equipment

General

- Site-specific plans
- Field logbook, chain-of-custody forms, other forms for documenting sample shipment
- Indelible black or blue ink pens and markers
- Sample containers with labels and preservatives
- Insulated coolers
- Bagged ice or "blue ice"
- Plastic zip-top bags
- Waterproof sealing tape
- Temperature, conductivity, pH, dissolved oxygen, and turbidity meters (with clean beakers or other appropriate containers), as required by the site-specific plans
- Monitoring/Screening instruments as required by the site-specific health and safety plan or sampling plan
- Decontamination supplies, as required by SOP 4-5
- Personal protective equipment (PPE), as required by the site-specific health and safety plan (at a minimum, hard hat, steel-toed shoes, safety glasses, and hearing protection are required)
- Latex or appropriate gloves
- Geoprobe rig (van, truck, or skid-mounted) with the following:
  - Probe rods 30-, 60-, and 90-cm lengths (1-, 2-, and 3-foot lengths)
  - Extension rods 30-, 60-, and 90-cm lengths (1-, 2-, and 3-foot lengths), couplers, and handle
  - Piston stop-pins (two each per rig, minimum)
  - Drive caps and pull caps (two each per rig, minimum)
  - Carbide-tipped drill bit for working in concrete- or asphalt-covered areas
  - O-rings

Geoprobe Soil Sampling Equipment

- Extruder rack and piston (if soil is to be extruded into a sample container - otherwise, the steel sample tube with the standard and Kansas stainless samplers or acetate liner with the large bore Sampler may be shipped to the laboratory, as indicated in the site-specific plans)

- Assembled soil samplers (i.e., standard 25-cm or 60-cm [10-inch or 24-inch] sampler, Kansas stainless sampler, or large bore sampler - refer to the Geoprobe Systems Equipment and Tools Catalog for specific parts for each sampler)

Geoprobe Soil Gas Sampling Equipment

- Expendable drive points (one each per sample location, plus spares)
- Extension rod ram
- 10 millimeter (mm) (3/8-inch) polyethylene (Teflon -lined) tubing and PRT adapter
- Vacuum or sampling system
- Syringe
- PRT adapter
- PRT expendable point holder

Geoprobe Groundwater Sampling Equipment

- Expendable drive points (one each per sample location, plus spares)
- Mill-slotted well point or screen point groundwater sampler assemblies
- Extension rod ram
- 10-mm (3/8-inch) polyethylene (Teflon -lined) tubing
- Check valves (if using Waterra system)
- Peristaltic pump
- Mini-bailer (and thin nylon line)

5.0 Procedures

Procedures common to all three sampling methods are discussed below.

Prior to sampling:

- Arrange utility clearance.
- Decontaminate all Geoprobe equipment according to SOP 4-5, Field Equipment Decontamination.
- Don the appropriate PPE as dictated by the site-specific health and safety plan.
- If the sampling site is in a concrete- or asphalt-covered area, drill a hole using the rotary function and a specially designed 3.75-cm or 5-cm (1.5-inch or 2.0-inch) diameter carbide-tipped drill bit. Otherwise, the area needs to be cleared of heavy underbrush and immediate overhead obstructions.

After sampling is completed:

- Thread the pull cap onto the top probe rod and retract the probe rods.
- Seal the borehole with sand, neat cement, or bentonite grout, if necessary.
- Record all appropriate data in the field logbook and on the chain-of-custody forms as outlined in CDM Federal SOP 4-1, Field Logbook Content and Control and CDM Federal SOP 2-1, Packaging and Shipping Environmental Samples.
- Decontaminate the sampling equipment according to CDM Federal SOP 4-5 "Field Equipment Decontamination."

5.1 Soil Sampling

Assembly

1. Assemble the sampling device as follows:

   - Screw the cutting shoe to the bottom end of the sample tube (unless using standard probe drive sampler, which has built-in cutting edge).
   - Screw the piston tip onto the piston rod.
   - Screw the drive head onto the top end of the sample tube.
   - If using Teflon liner, insert liner into sample tube.
   - Slide the piston rod into the sample tube, leaving the piston tip sticking out of bottom end of the sample tube.
   - Screw the piston stop-pin onto the top end of the piston rod in a counter-clockwise direction.

2. Attach the assembled sampler onto the leading probe rod. A 30-cm (12-inch) probe rod is recommended to start the 60-cm (24-inch) standard and large bore samplers.

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler. Replace the 30-cm (12-inch) rod with a 90-cm (36-inch) rod as soon as the top of the sampler is driven to within 15 cm (6 inches) of the ground surface.

4. Advance the sampler to the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

Stop-pin Removal

5. Move the probe unit back from the top of the probe rods and remove the drive cap.

6. Lower the extension rods into the inside diameter of the probe rods using extension rod couplers to join the extension rods.

7. Attach the extension rod handle to the top extension rod and rotate the handle clockwise until the leading extension rod is screwed into the piston stop-pin. Continue to rotate the handle clockwise until the stop-pin disengages from the drive head.

8. Remove the extension rods and attached piston stop-pin from the probe rods.

Sampling

9. Replace the drive cap, mark the top probe rod with a marker or tape at a distance above the ground equal to the length of the sample tube (either 30 or 60 cm [12 or 24 inches]).

10. Advance the probe rods using the hydraulic hammer the length of the sample tube (either 30 or 60 cm [12 or 24 inches]).

11. Replace the drive cap with the pull cap and retract the probe rod(s). Secure the rod(s) with a clamp or by hand during removal so they do not fall back down the resulting borehole.

12. Detach the sampler from the lead probe rod, verifying that sufficient sample volume was recovered (the length of sample contained within the tube is approximately equal to the length of exposed piston rod).

13. Disassemble the sampler. If the sample is to be analyzed for VOCs, then the sample tube or liner should be sealed immediately by placing a Teflon septa over the ends and covering them with plastic caps.

14. If samples do not require VOC analysis, they may be extruded from the sampler and transferred to the sample jars specified in the site-specific plans or SOP 2-1, Packaging and Shipping Environmental Samples. Samples can be extruded by one of two methods:

    - Using the Geoprobe rig and the extruder rack (Figure 2), position the extruder rack on the foot of the Geoprobe derrick; insert the sample tube into the extruder rack with cutting end up; and position the extruder piston, pushing the sample out of the sample tube using the "probe" function. Catch the sample as it exits beneath the extruder in a sample jar or stainless steel mixing bowl. Samples to be collected for VOCs will be collected directly from the sample tube into the sample jars.

    - Lightly tap the side of the sample tube with a hammer while also lightly pushing the Piston Rod.

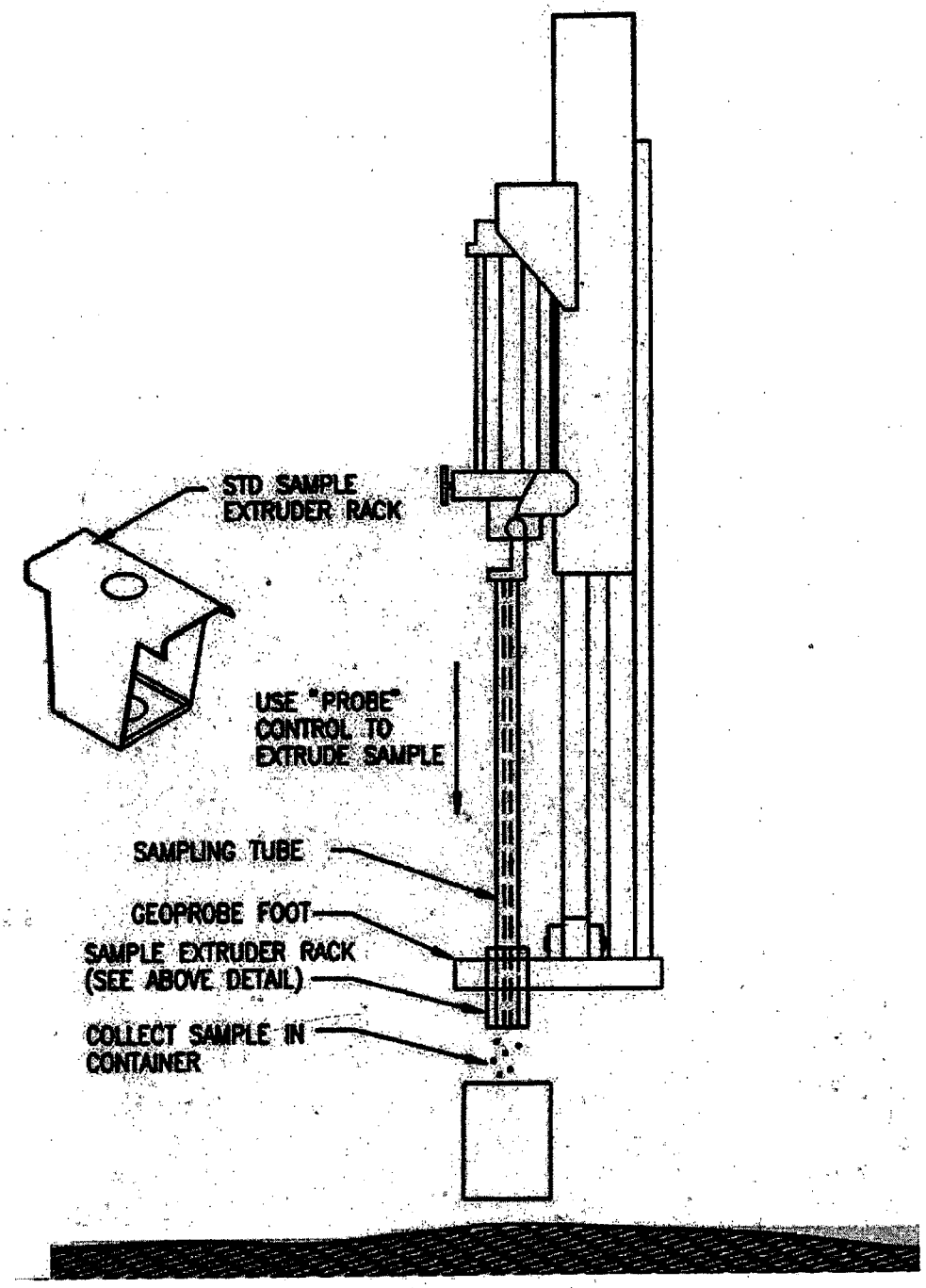
15. Label the sample liner or sample jars as required, securing the label by covering it with a piece of clear, waterproof tape.

16. Homogenize the sample in a stainless steel bowl with a stainless steel spoon or spatula. Transfer the sample from the bowl to the sample container.

17. Clean the outside of the sample jars and place individual samples into sealable bags and seal closure.

18. Place samples in a cooler containing ice according to SOP 2-1, Packaging and Shipping Environmental Samples.

Figure 2
Sample Extruder Rack



5.2 Soil Gas Sampling

Assembly

1. Assemble the sampling device as follows (Figure 3):

   - Test fit the adapter with the PRT expendable point holder or retractable point holder to ensure that threads are compatible and fit together smoothly.
   - Attach the PRT adapter to flexible tubing equal in length to the depth of sampling (with some additional for sampling activities).
   - Secure PRT adapter with a length of electrician's tape and check the condition of the O-ring attached to the end of the PRT adapter.
   - Screw the PRT expendable point holder into the bottom of the lead probe rod.
   - Attach an expendable drive point to the bottom of the PRT expendable point holder.

2. Attach the assembled sampler onto the leading probe rod. A 30-cm (12-inch) probe rod is recommended to start the 60-cm (24-inch) standard and large bore samplers.

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler. Replace the 30-cm (12-inch) rod with a 90-cm (36-inch) rod as soon as the top of the sampler is driven to within 15 cm (6 inches) of the ground surface.

4. Advance the sampler to 1 foot past the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

Sampling

5. Replace the drive cap with a pull cap and retract the probe rods approximately 30 cm (1 foot).

6. Move the probe unit back from the top of the probe rods and remove the drive cap.

7. Push the drive point out of the PRT expendable drive point holder with extension rods fitted with a ram.

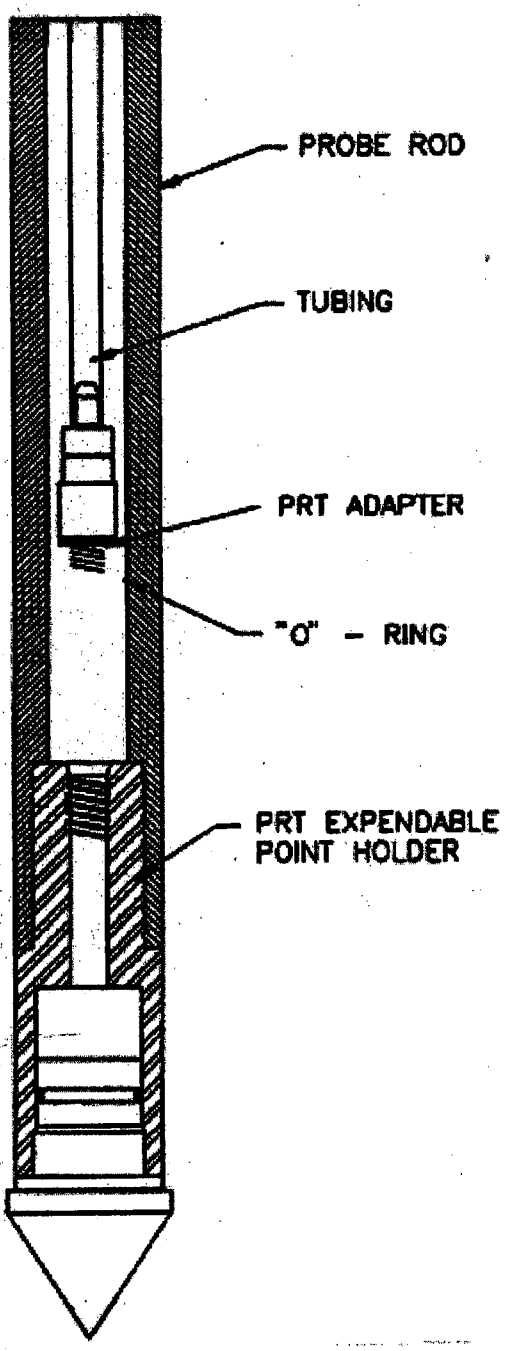
8. Remove the extension rods from the probe rods.

9. Insert the adapter end of the tubing down the inside diameter of the probe rods, feeding the tubing down until the adapter contacts the top of the PRT expendable point holder.

10. Holding the out-of-hole end of the tubing, apply downward pressure while turning in a counter-clockwise direction to screw the adapter into the PRT expendable point holder.

11. Pull lightly on the tubing to ensure that the threads have engaged.

Figure 3
PRT Soil Gas Sampling System



12. Connect the out-of-hole tubing to a vacuum or sampling system. A short section of inert silicon tubing may be connected to the end of the out-of-hole tubing so that a sample can be collected with a glass gas chromatograph (GC) syringe.

13. Start the vacuum or sampling system and allow the system to operate for 2 to 3 minutes to ensure that a sufficient volume of air has been run through the tubing. Document the depth, vacuum pressure, and purge duration in logbook. **Note:** Make sure the vacuum evacuation pump is able to pull vapors from the formation. Excessive vacuum may occur in clay/clayey units resulting in insufficient sample volume.

14. Collect sample using the method specified in the site-specific plan.

15. Label all sample containers as required, securing the label by covering it with a piece of clear, waterproof tape.

16. Remove the tubing from the probe rods. Dispose of the tubing or set it aside for decontamination.

17. Remove probe rod(s) from hole. Leave tubing in place for longer term monitoring.

5.3 Groundwater Sampling

Assembly

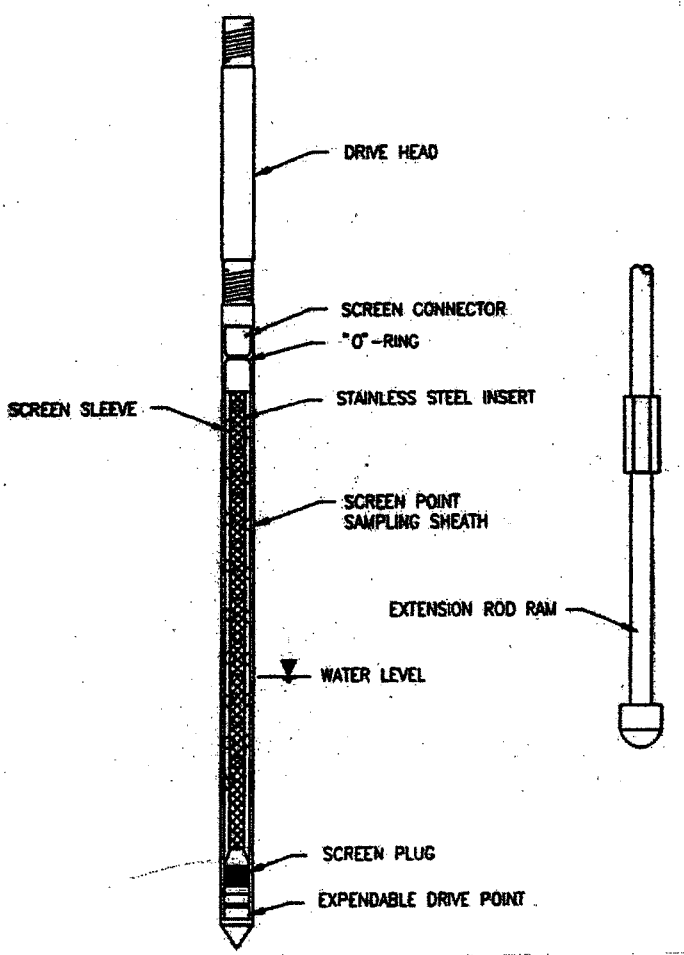
1. Assemble the screen point groundwater sampler (see Geoprobe Systems Equipment and Tools Catalog, Groundwater Sampling Tools, pp. 5.1-5.12) as follows (Figure 4):

   - Push the screen insert and plug into the screen sleeve from the bottom. The bottom end has one drain hole.
   - Push the screen connector over the top end of the screen sleeve and push the screen connector pin into place. The pin must be held in place as it has a loose fit.
   - Insert the screen sleeve, screen connector first, into one end of the sampler sheath.
   - Slide the drive point seat over the end of the screen assembly that protrudes from the sampler sheath. Thread it in until tight using a 22-mm (7/8-inch) wrench.
   - Push the screen assembly just far enough into the sampler sheath that an expendable drive point can be pushed into place in the drive seat.
   - Screw the groundwater drive head with the O-ring end first into the open end of the sampler sheath.
   - O-rings are installed at various critical places in the sampler assembly. Ensure that all O-rings have not been worn and that the connections made at O-ring locations are tight.

   The Mill-slotted well point does not need any assembly.

2. Attach the Mill-slotted well point, or screen point groundwater sampler, onto the leading probe rod. A 30-cm (12-inch) probe rod is recommended to start either groundwater sampler.

Figure 4
Groundwater Sampling



Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler using either the hydraulic hammer or hydraulic probe mechanism on the Geoprobe rig. Replace the 30-cm (12-inch) rod with a 90-cm (36-inch) rod as soon as the top of the sampler is driven to within 15 cm (6 inches) of the ground surface.

4. Advance the sampler to the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

Sampling

5. Move the probe unit back from the top of the probe rods and remove the drive cap.

6. The next step varies depending on the type of sampler being used:

   - Mill-slotted well point - measure and record the water level, allowing time for the water level to reach equilibrium.

   - Screen Point groundwater sampler - attach the pull cap to the top probe rod, retract the probe rods approximately 60 cm (2 feet), push the screen into the formation using extension rods fitted with a ram, remove extension rods from the probe rods, and measure and record the water level, allowing time for the water level to reach equilibrium.

7. Label all sample containers as required, securing the label by covering it with a piece of clear, waterproof tape.

8. Collect groundwater samples using one of three methods (as outlined in site-specific plans) described below:

   - Collect sample from the inside diameter of the probe rods using a decontaminated mini-bailer. Follow CDM Federal SOP 1-5, Groundwater Sampling Using a Bailer.

   - Collect sample using a peristaltic pump and flexible tubing system.

   - Collect sample using a check valve (Waterra-type valve) attached to the bottom of 10-mm (3/8-inch) diameter tubing. The tubing is lowered into the probe rods below the top of the water table, check valve-end first. Water sample is collected through the tubing by rapidly oscillating the tubing up and down creating an inertial pump.

9. Clean the outside of the sample containers and place individual samples into sealable bags and seal closure.

10. Place samples in a cooler containing ice according to SOP 2-1, Packaging and Shipping Environmental Samples.

6.0 Restrictions/Limitations

The Geoprobe sampling system is not designed for collecting large sample volumes, thereby limiting the number of analytical parameters. Sample recovery rates may be reduced in soils with substantial amounts of gravel and/or cobbles. Depending on sampling depths and intervals, a typical sample production rate of between 10 and 15 samples per day can be expected.

The most efficient sampling depth is limited by the geologic and hydrogeologic conditions. Practical, efficient sampling depths should be limited to approximately 6 meters (20 feet) under most conditions. However, sampling depths in excess of 20 meters (65 feet) have been achieved in unconsolidated, homogeneous sandy soils; attainable depths will be greatly reduced in tighter formations and in soils with gravel and cobbles.

The presence of gravel and cobbles in soils will likely damage soil sampling tubes and possibly probe rods, couplers, stop-pins, and other probing equipment. A sufficient supply of replaceable equipment should be kept onsite in the event of damage or breakdowns. This often requires replacement at the project's - not the subcontractor's - expense. A copy of the Geoprobe Systems Equipment and Tools Catalog should also be kept onsite; Geoprobe Systems provides overnight deliveries.

Prior to conducting the Geoprobe sampling event, underground utilities and structures must be demarcated on the ground surface. The local utility companies must be notified at least 72 hours prior to the scheduled sampling event to allow sufficient time to locate and mark the utility lines. The selected sampling location should be a safe distance from the demarcated utility. In some cases, records regarding utility locations may not exist. In any event, a good practice is to push the probe rods the first few feet, rather than hammering, to ensure that no utilities, underground storage tanks, or other subsurface structures are present.

7.0 References

Geoprobe Systems, *The Probe-Drive Soil Sampling System*, September 1991.

Geoprobe Systems, *Equipment and Tools Catalog*, 1992.

Lithologic Logging

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1.0 Objective

This standard operating procedure (SOP) governs lithologic logging of core, cuttings, split-spoon samples, and subsurface samples collected during field operations at sites where environmental investigations are performed by CDM Federal Programs Corporation (CDM). The purpose of this SOP is to present a set of descriptive protocols and standardized reporting formats to be used by all investigators in making lithologic observations. It prescribes protocols for recording basic lithologic data including, but not limited to, lithologic names, texture, composition, color, sedimentary structures, bedding, lateral and vertical contacts, and secondary features such as fractures and bioturbation.

The goal of this SOP is to provide a set of instructions to produce uniform lithologic descriptions and to present a list of references to help in this task.

2.0 Background

2.1 Definitions

The following list of definitions corresponds to the description sequences outlined in Section 5.2.1. They are provided to aid the lithologic logger in what to look for when following the sequences. An example lithologic log is given in Attachment A.

Name of Sediment or Rock - In naming unconsolidated sediments, the logger should use field equipment and reference charts to help identify the grain-size distribution and should name the material according to the procedure in Section 5.2.1. In naming sedimentary, igneous, and metamorphic rocks, the logger should examine the specimen for mineralogy and use the appropriate classification chart in the attachments.

Texture - In examining unconsolidated sediments, the texture shall refer to the grain-size distribution, particle angularity, sorting, and packing. The logger should provide estimates of the grain sizes present using Attachment B and C. When larger particles such as cobbles are present, determine the size of the particles and give a percentage estimate. The sediment particles should be examined for angularity by comparing with Attachment B and the sorting should be determined by percentage estimation. The logger should note that the Unified Soil Classification System (USCS) uses the term grading to describe how the materials are sorted. (A poorly sorted unconsolidated material is well graded.) In examining igneous rocks, texture refers to whether the specimen is aphanitic, phaneritic, glassy, fragmental, porphyritic, or pegmatitic. Attachment D has more specific definitions of these terms. For metamorphic rocks, texture refers to whether the specimen has a foliate structure (slaty, phyllitic, schistose, or gneissic) or nonfoliate structure (granular).

Color - Color may be determined using the appropriate Munsell color chart (soil or rock) and listing the Munsell number that corresponds to the color. If an unconsolidated material is mottled in color, the ranges in color should be described. When describing core samples with several individual colors such as in phaneritic textures, individual color names should be listed, and an overall best color name should be given.

Sedimentary Structures - This term refers primarily to unconsolidated sediments and sedimentary rocks. There are several different sedimentary structures, and the logger is referred to Compton's *Manual of Field Geology* (1962) book for more details. Among the more common structures are bedding, cross-bedding, laminations, and burrows. These structures should only be included in the description if found in the samples.

Degree of Consolidation - The degree of consolidation is applicable to sedimentary rocks and unconsolidated sediments and refers to how well the material has been indurated. Unconsolidated sediments may be compacted somewhat and should be described as loose, moderately compacted, or strongly compacted. In some cases they may be slightly cemented by caliche and should be described as slightly cemented, moderately cemented, or strongly cemented. Sedimentary rocks are typically indurated but may vary in the degree of cementation. These materials should be described as friable, moderately friable, or well indurated. When describing the cementing material, a test for reaction to hydrochloric acid (HCl) should be done and results recorded under the description. If the logger believes he/she can identify the cementing material, then it should be included in the description.

Moisture Content - Moisture content refers to the amount of water within the sediment or the matrix. Typically sedimentary rocks and unconsolidated sediments may have water within and should be described as dry, moist, or wet. Igneous and metamorphic rocks may have water within fractures and cavities. The presence of water and pertinent observations that may help in site evaluation in these rocks should be noted.

Presence of Fractures, Cavities, and Secondary Mineralization - The rock types that may be encountered during drilling may have fractures or joints present within them. Should fractures be observed, they should be noted and a description as to the density of fractures should be given. Cavities or vugs may be present, and the density of voids as well as a size estimation should be given. If fractures or cavities contain evidence of secondary minerals such as zeolites, clays, or iron oxides, then a description of the mineral fill should be added.

Evidence of Contamination - The logger should examine the core and note any obvious signs of contamination such as streaking, free product, odor, or discoloration. These observations should be noted in the field book as should any readings from the photoionization or flame ionization detector (PID/FID). PID/FID hits should be recorded on the Lithologic Log Form also.

Description of Contacts - The logger should note any significant change in lithology. These changes may be gradational contacts within sediments or may be sharp contacts such as sediments over rocks. The contacts should be noted as to whether they are erosional, gradational, or sharp, and the depth below the surface should be noted.

Composition - The composition of the rock refers to the mineralogy of the material encountered. For sedimentary rocks, it is important to note the matrix composition and use Attachment E in naming. In igneous and metamorphic rocks, the minerals that make up the rock should be stated and an estimation of their percentage should be noted. The classification charts listed in Attachments D and F provide a description of common compositions.

Degree of Vitrification - This term is applicable to volcanic rocks and refers to the degree of welding in pyroclastic materials. Describe these rocks as poorly welded, moderately welded, or strongly welded.

2.2 Discussion

The installation of monitoring wells, piezometers, and boreholes is a standard practice at many sites requiring environmental investigations. The installation of these devices requires that a trained geologist, or other earth scientist, provide lithologic descriptions as they encounter subsurface material during auguring or drilling. In evaluating these lithologic descriptions from different boreholes, monitoring wells, or piezometers, it is sometimes possible to correlate similar units. To help in this task, it is important to provide uniform and consistent descriptions.

In describing lithologies, it is helpful to have a set of references covering items such as the classification of igneous, metamorphic, and sedimentary rocks; grain-size percentage estimation; particle shape; grain-size charts; and lithologic symbols. In order to make lithologic descriptions produced by CDM staff as uniform and consistent as possible, this SOP provides a list of references to be used in the field. This SOP also provides a sequence for recording information on a standardized log form to make descriptions as uniform and consistent as possible.

2.3 Associated Procedures

- CDM Federal SOP 4-1, Field Logbook Content and Control

3.0 Responsibilities

Geologist - The field person performing lithologic logging is responsible for making a consistent and uniform log and for turning in field forms and logbooks to the field team leader (FTL).

Field Team Leader - The FTL is responsible for maintaining logbooks and forms and for approving techniques of lithologic logging not specifically described in this SOP.

4.0 Required Equipment

The description of subsurface lithologies requires a minor amount of field equipment for the geologist. This section provides a list of equipment to be used by the lithologic logger but does not include equipment such as drill rigs, PID/FID, sampling equipment, and personal protection equipment. The following is a general list of equipment that may be used:

- Field logbook and Lithologic Log Form
- Clipboard
- Dilute (10 percent) HCl
- Plastic sheeting

- PVC sampling trays
- Waterproof pens
- No. 2 sieve
- 10x magnifying hand lens
- Reference field charts

5.0 Procedures

5.1 Office

- Obtain field logbook and Lithologic Log Forms
- Coordinate schedules/actions with FTL
- Obtain necessary field equipment (i.e., hand lens, 10 percent HCl)
- Obtain CDM reference field charts
- Review field support documents (i.e., sampling plan, health and safety plan)
- Review applicable geologic references such as U.S. Department of Agriculture (USDA) Soil Conservation Survey Soil Surveys and/or geologic maps

5.1.1 Documentation

Individuals performing lithologic logging will record their observations in a commercially available, bound field logbook (e.g., Lietz books) and/or on individual Lithologic Log Forms. Lithologic loggers will follow the general procedures for keeping a field logbook (SOP 4-1). When using a bound field logbook, record the same data required on the Lithologic Log Form. Data from the field logbook must be transcribed to the Lithologic Log Form if filling in the form in the field is not feasible. However, the data must be the same as that recorded in the field logbook. Editing of field logbook data is not allowed. In addition, if data are transcribed to the Lithologic Log Form, it should be done within 1 day of the original data recording. All blanks in the Lithologic Log Form must be filled out. If an item is not applicable, an "NA" should be entered.

The Lithologic Log Form should be filled out according to the following instructions:

The top part of the form contains general information. The project name and number must be filled in to identify the site. The date that drilling was started and completed, and the well number within the site should be stated. The name of the person logging the well is recorded as is the total depth drilled. Weather condition descriptions should correlate with what is written in the logbook. The last item to be completed is the name and company of the driller and the type of drill rig and bits used.

The bottom part of the form shall be completed according to the instructions provided within this section and according to the sequence provided in Section 5.2.1. The depth column refers to the depth below ground surface and should be provided in feet. The tick marks can be arbitrarily set to any depth interval depending on the scale needed except where client requirements dictate the spacing. The lithology column should contain a schematic representation of the subsurface according to the symbols found in Attachment G. Use a single X to mark the area where no core was recovered, and notes should be recorded as to why the section was not recovered. The X should be marked from the top to the bottom of the section so that the entire interval is marked. If the geologist can interpret the probable lithology of the missing section with reasonable confidence, they may fill in the symbols behind the X. Sharp or abrupt contacts between lithologies will be indicated by a solid horizontal line.

Gradational changes in lithologic composition will be shown by a gradual change of lithologic symbol in the appropriate zone. PID/FID hits should be recorded within the PID/FID column at the appropriate depth, if applicable. Blow counts specifically refer to the number of hammer blows it takes to drive a split-spoon into the ground. Usually this is recorded as the number of blows per 6 inches but may vary. The recording of blow counts provides a relative feel for the cohesiveness of the formation. The individual recording lithologic logs should ask the FTL whether it is required information. The description column is the most important part of the Lithologic Log Form and is where the lithology is described. In completing this section, use the applicable reference charts and complete according to the sequence in Section 5.2.1. The sample interval column is reserved for noting any samples taken and processed for the laboratory. The sample number shall be filled in at the appropriate depth. The last column refers to the percent core recovery. The individual performing lithologic logging should determine the amount recovered and write the percentage at the appropriate depth.

In addition to the information on the lithologic form, the logger should fill in appropriate information into the logbook when there is a rig shutdown, rig problems, failures to recover cores, or other issues.

5.2 General Guidelines for Using and Supplementing Lithologic Descriptive Protocols

This SOP is intended to serve as a guide for recording basic lithologic information with emphasis on those sediment or rock properties that affect groundwater flow and contaminant transport. The fields of specialization of geologists using this SOP will vary. If the user has expertise in a particular field of petrology or soil science that allows for descriptions of certain geologic sections beyond the basic level required by this SOP, they may expand their descriptions. This should be done only with approval of the FTL. The descriptive protocol presented here must be followed in making basic observations. Any further descriptions must follow a protocol that is published and generally recognized by the geologic community as a standard reference. General lithologic description will not include collecting detailed information such as can be obtained from sieve analysis or petrographic analysis. This SOP is a guide for recording visual observations of samples in the field aided by a 10x hand lens and the other simple tools. Field descriptions should be supplemented by petrographic analysis and sieve analysis when the FTL needs data on numerical grain-size distributions, secondary porosity development, or other data that can be collected by these methods.

This SOP includes protocols for describing igneous, metamorphic, sedimentary rocks, and unconsolidated materials. Common abbreviations are given in Attachment H. This SOP includes charts to be used for classification and naming of rocks, sediments, and soils and descriptions of texture, sedimentary structures, and percentage composition of grains. There is also a chart of lithologic symbols to be used and a list of abbreviations. For charts covering other observations or field procedures not specified by this SOP, the user is referred to the following for more information:

- *Compton's Manual of Field Geology* and *American Geological Society (AGI) Data Sheets for Geology in the Field, Laboratory, and Office* contain other reference charts applicable to descriptions. The source of the chart used must be recorded on the Lithologic Log Form or in the field logbook.
- The Munsell soil color chart may be used for descriptions of color.
- The *Dictionary of Geological Terms* (AGI) is to be used for definitions of geological terms.

Some observations will be common to all rock and soil descriptions. All descriptions should include as appropriate: name of sediment or rock, color, sedimentary structures, texture, moisture content, composition, fabric, significant inclusions, and degree of consolidation or induration. The description of each category should be separated by a semicolon. Each section that discusses descriptions of a particular lithology provides a sequence for recording observations. Follow these sequences for all descriptions. All lithologic descriptions shall be segregated from interpretive comments by recording them in the field book.

Secondary features affecting porosity and permeability such as fractures (joints or faults), cavities, and/or bioturbation should be described if observed. Exact measurement of apparent bed thicknesses should be made when logging core and should supplement terminology such as "thin" or "thick." Particular attention is to be given to recording exact locations of water tables, perched saturated zones, and description of contaminants that may be visible.

In some cases individuals logging may wish to describe materials such as unconsolidated sediments and soils according to different systems such as the USCS or USDA Soil Taxonomy System. These descriptions can provide additional information from what is required by this SOP. If an individual is competent in using other description methods, then they should do so with permission from the FTL.

It is often more practical to use abbreviations for often repeated terminology when recording lithologic descriptions. For the terms given in this SOP, its attachments, or the associated charts to be used for description in the field, use only the designated abbreviations. Other abbreviations are allowed; however, the abbreviation and its meaning should be recorded on the lithologic log the first time it is used and should be recorded at least once for every well or boring log. Loggers are cautioned to limit the use of abbreviations to avoid producing a lithologic log that is excessively cryptic.

5.2.1 Protocols for Lithologic Description

This section describes the protocols for completing a lithologic description. The logger should use the appropriate portion of this section when describing cores. In recording descriptions of sedimentary sections from a whole core, it is possible to reduce the amount of description being written by at least two strategies. One is to look at as long of a section of core as possible, looking for the "big" picture. For instance, in a 20-foot-thick zone, the dominant lithology may be siltstone that is interrupted by several thin beds of another lithology such as gravel. This section description can be simplified by writing: 35-55 below ground surface (bgs) = siltstone (with other descriptors) except as noted; 37.5-38.5 gravel zone (with descriptors); 40-42 pebble zone (with descriptors); etc. This also aids in "seeing" the thickest unit designations possible for use in modeling. Another acceptable way to describe the same interval would be: 35-37.5 siltstone; 37.5-38.5 gravel zone (with descriptors); 38-40 same as 35-37.5; 40-42 pebble zone (with descriptors); etc.

Description of Unconsolidated Material

Unconsolidated material comprises a significant portion of the sections of interest at CDM sites. The shallow subsurface is very important to the hydrologic investigation, as this is the portion of the geologic section where infiltration first occurs. Much of the contamination at sites being investigated is surface contamination and therefore lies on, or within, the upper portion of the surficial material.

For the purpose of this SOP, soil refers to the upper biochemically weathered portion of the regolith and not the entire regolith itself. Soils are to be described as unconsolidated material and should use the same

description format. The scientist may use the USCS classification if consistent with project objectives (Attachment K). More detailed soil descriptions should only be made in addition to descriptions outlined below.

Descriptions of unconsolidated sediments should follow the following sequence:

- Name of sediment (sand, silt, clay, etc.)
- Texture
- Composition of larger-grained sediments
- Color
- Structure
- Degree of consolidation and cementation
- Moisture content
- Evidence of bioturbation
- Description of contacts

In naming unconsolidated material (refer to Attachment I - Naming of Unconsolidated Materials), the particle size with the highest percentage is the root name. When additional grains are present in excess of 15 percent, the root name is modified by adding a term in front of the root name. For instance, if a material is 80 percent sand and 20 percent gravel, then it is gravelly sand. If the subordinate grains comprise less than 15 percent but greater than 5 percent, the name is written: _____(dominant grain) with _____(subordinate grain). For example, a sediment with 90 percent sand and 10 percent silt would be named a sand with silt. If a sediment contains greater than 15 percent of four particle sizes, then the name is comprised of the dominant grain size as the root name and modifiers as added before. For example, if a material is 60 percent sand, 20 percent silt and 20 percent clay the name would be a silty clayey sand. If a material is 70 percent sand, 20 percent silt and 10 percent clay, it would be a silty sand with clay. When large cobbles or boulders are present, their percentage should be estimated and their mineralogy recorded. Use AGI Data Sheet 29.1 (Attachment B) for grain terms. Refer to Attachment J for an example sorting chart.

Description of Sedimentary Rocks
Sedimentary rocks consist of lithified detrital sediments such as sand and clay, chemically precipitated sediments such as limestone and gypsum, and biogenic material such as coal and coquina. The classification scheme for naming these rocks is found in Attachment E - Classification of Sedimentary Rocks.

Descriptions for sedimentary rocks should be given in the lithologic log in the following sequence:

- Name of rock
- Texture
- Color
- Sedimentary structures
- Degree of composition
- Presence of fractures or vugs
- Moisture content
- Bioturbation
- Description of contacts

Description of Igneous and Metamorphic Rocks
Igneous rocks, volcanic and plutonic, and metamorphic rocks are not as commonly observed at work sites, but they may be found interspersed in the sedimentary section as ash layers and as bedrock. Where they form bedrock, the development of fractures and vugs is important to their hydrologic properties. If the logger is unsure of the name of the rock because of difficulty in determining mineralogy, the name shall be accompanied by a question mark. Attachments D and F provide a classification system for these materials.

Igneous and metamorphic rock descriptions should follow the general format:

- Name of rock
- Texture
- Color
- Degree of induration for volcaniclastics
- Composition
- Presence of fractures or vugs
- Presence of secondary mineralization
- Moisture content
- Weathering

6.0 Restrictions/Limitations

Only geologists, or similarly qualified persons trained in lithologic description, are qualified to perform the duties described in this SOP. The FTL for a project will have the authority to decide whether or not an individual is qualified.

7.0 References

American Geological Society, *American Geological Society Data Sheets for Geology in the Field*, Laboratory, and Office, 3rd Ed, 1989.

American Geological Society, *Dictionary of Geologic Terms*, Anchor Press, Garden City, New York, 1960.

Compton, R.R., *Manual of Field Geology*, John Wiley & Sons Inc., New York, New York, 1962.

Munsell Color Chart, Soil Test Inc., Evanston, Illinois, 1975.

U.S. Department of Agriculture Soil Conservation Service, *Soil Taxonomy*, U.S. Government Printing Office, Washington, D.C., 1972.

Woodward, L.A., *Laboratory Manual Physical Geology*, University of New Mexico Printing, Albuquerque, New Mexico, 1988.

8.0 Attachments

Note: These Attachments are for informational purposes. Other equivalent charts such as USCS or logs may be used.

Attachment A - CDM Federal Programs Corporation Lithologic Log

Attachment B - Grain-Size Scale; Graph determining size of sedimentary particles, particle degree of roundness charts

Attachment C - Comparison Chart for Estimating Percentage Composition

Attachment D - Classification of Igneous Rocks

Attachment E - Classification of Sedimentary Rocks

Attachment F - Classification of Metamorphic Rocks

Attachment G - Lithologic Symbol Chart

Attachment H - Common Abbreviations

Attachment I - Naming of Unconsolidated Materials

Attachment J - Sorting Chart

Attachment K - Example of Unified Soil Classification System (USCS)

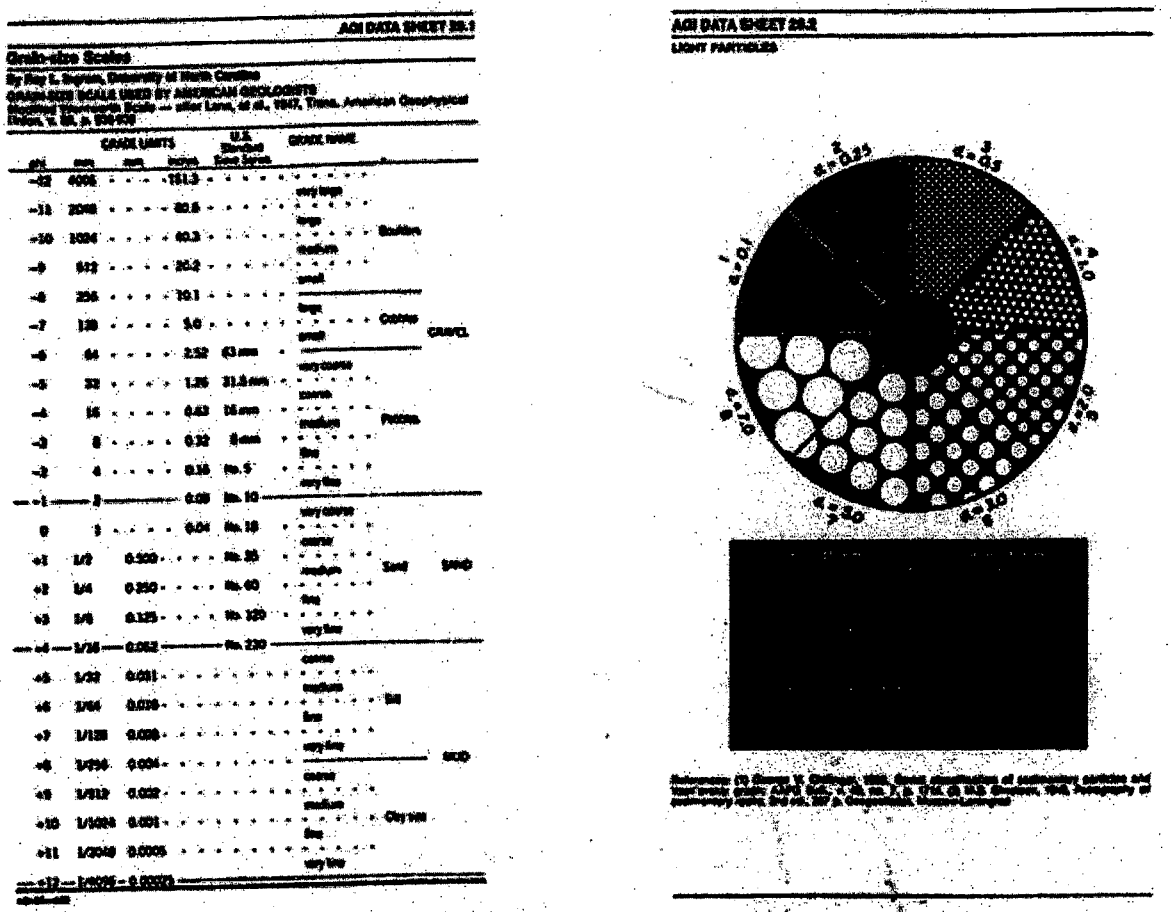
Attachment A

CDM Federal Programs Corporation Lithologic Log		
Boring No. _____		Sheet ____ of ____
Project:	Project No.:	Date Started:
Well No.:	Rig:	Date Ended:
Logged By:	Total Depth:	Driller:
Weather:		Bits:

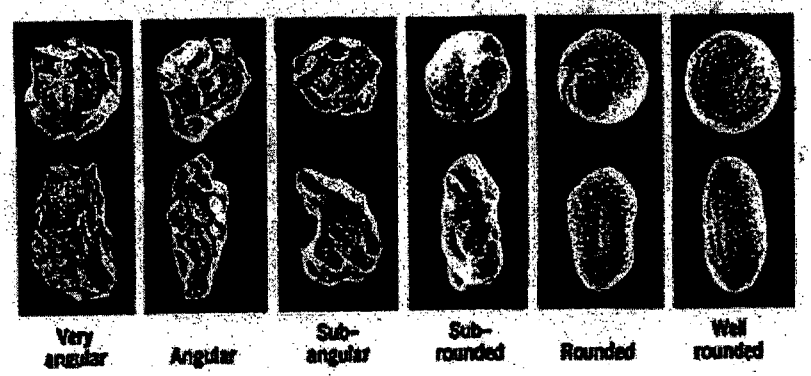
Depth	Lithology	Sample Interval	% Recovery	PID/ FID	Blow Counts	Description

Proportions		Cohesionless		Cohesive Consistency	
		Blows		Blows	
trace	0 to 10%	loose	0 to 10	0-4	soft
little	10 to 20%	med dens	10 to 30	4-8	med stiff
some	20 to 35%	dense	30 to 50	8-15	stiff
and	35 to 50%	very dense	50+	15-30	very stiff
				30+	hard

Attachment B

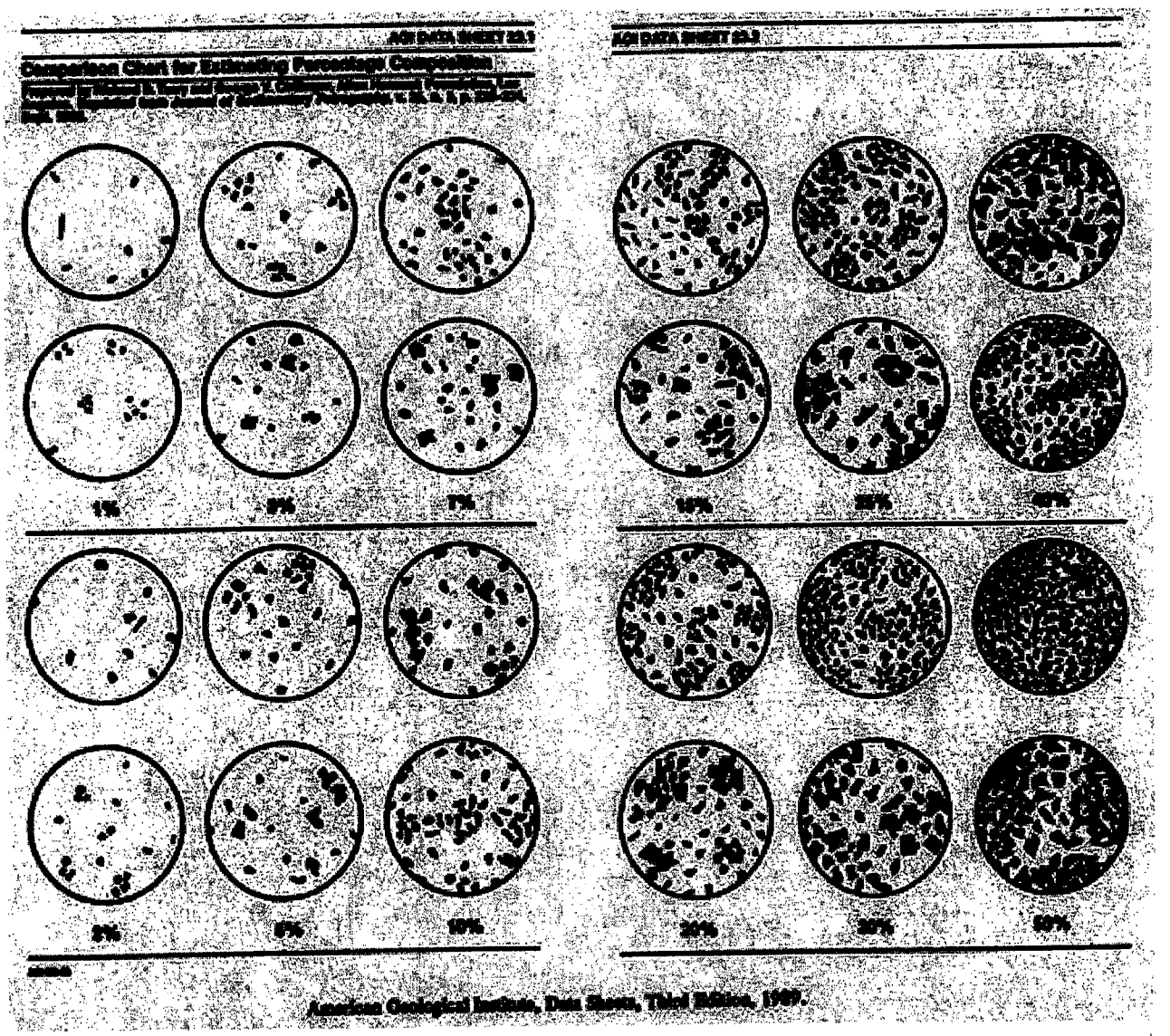


American Geological Institute, Data Sheets, Third Edition, 1969.



Compton, R.R., Manual of Field Geology, 1962.

Attachment C



Attachment D

		Quartz >10% Abundant feldspar Mafic minerals minor	Quartz <10% Abundant feldspar Mafic minerals moderate	Feldspar abundant Mafic Minerals 40-70%; Quartz minor or absent	Mafic minerals >70%
Color Index		Light Color	Intermediate color	Dark	Dark
Chemistry		SiO_2 70%	SiO_2 60%	SiO_2 50%	SiO_2 40%
	Phaneritic (visible with naked eye)	Granite (Gr)	Diorite (Dr)	Gabbro (Gb)	Peridotite (Pr) (mostly olivine)
TEXTURE	Aphanitic (microscopic)	Rhyolite (Ry) (quartz phenocrysts)	Andesite (An) (feldspar or mafic phenocrysts; no quartz)	Basalt (Ba)	Komatiite (Km) (very rare)
		Felsite (Fl) (no phenocrysts)			
	Glassy	Obsidian (ob) Pumice (Pu)		Rare	
	Glassy-Fragmental (Pyroclastic)	Tuff <4mm (Tf) Breccia >4mm (Br)		Rare	

Attachment E

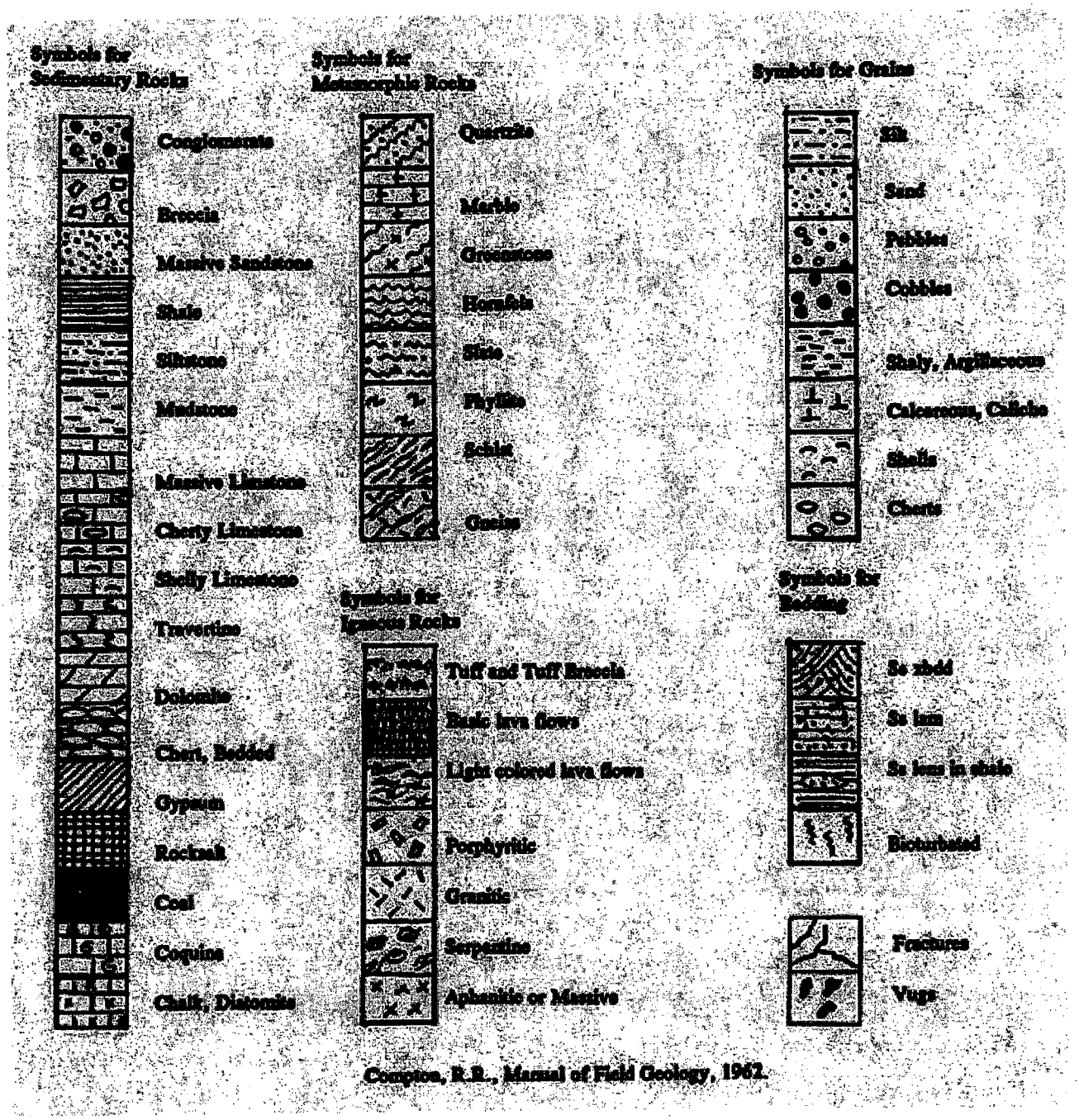
Classification of Sedimentary Rocks

Detrital				
	Rudaceous (clast diameter > 2 mm)	Gravel	Rounded Clasts	Conglomerate (Cg)
			Angular Clasts	Breccia (Br)
	Arenaceous (clast diameter between 0.0625 mm [1/16 mm] and 2 mm)	Sand	Mineral composition and detrital matrix content varies. Additional detrital matrix qualifiers (arenite or wacke) and mineral composition qualifiers (quartz, arkose, feldspathic, etc.) may be necessary.	Sandstone (Sa)
	Argillaceous (clast diameter <0.0625 mm)	Mud	Non-fissile along bedding planes, silt predominant over clay	Siltstone (Sls)
			Non-fissile along bedding planes, clay predominant over silt	Claystone
			Non-fissile along bedding planes, silt and clay fraction approximately equal or unknown	Mudstone (Ms)
			Fissile along bedding planes	Shale (Shl)
Chemical				
	Calcareous	Calcite (Calcium Carbonate)	Effervesces on contact with dilute HCl	Limestone (La)
		Dolomite (Calcium Magnesium Carbonate)	Pulverized sample effervesces on contact with dilute HCL	Dolomite (Dl), Dolostone
	Siliceous	Quartz (Silicon Dioxide)	Hard, dense, fractures conchoidally	Chert (Ch)
	Evaporites	Hydrated Calcium Sulfate	Earthy and crumbly	Gypsum (Gy)
		Calcium Sulfate	Usually exhibits indistinct stratification	Anhydrite
		Halite (Sodium Chloride)	Cubic cleavage	Rock Salt (Na)
Organic (Organogenetic or Biochemical)				
	Calcareous	Fossil shells and fragments	Loosely cemented fragmental limestone	Coquina (Cq)
		Foraminiferal shells	Soft, micritic limestone	Chalk (Chk)
		Calcite or aragonite	Derived from evaporation of spring water	Travertine (Tvr)
	Siliceous	Diatom shells (saltwater or freshwater organisms)	Light-colored, soft, friable, and porous siliceous deposit	Diatomite (Dm)
	Carbonaceous	Plant Remains	Degree of lithification varies-additional qualifiers such as peat, lignite, bituminous and anthracite may be necessary.	Coal (Cl)

Attachment F

Non foliate	granular; breaks across grains	quartz	Quartzite (Qzt)
	granular; grains clearly visible	calcite	Marble (Mbl)
	granular; grains altered and indistinct	plagioclase, chlorite, epidote hornblende	Greenstone (Grs)
	very fine-grained	indistinguishable; mostly submicroscopic micas and clays	Hornfels (Hnf)
Foliate	slaty	submicroscopic mica, quartz	Slate (Slt)
	phyllitic	microscopic mica, quartz	Phyllite (Pyl)
	schistose	microscopic mica, quartz, amphibole	Blueschist
		chlorite, mica plagioclase	chlorite schist (CL-Sch)
		muscovite, quartz	Muscovite (Ms) Schist (Sch)
		garnet, muscovite	Garnet (G) Muscovite (Ms) Schist (Sch)
		hornblende, plagioclase	Amphibolite (Amp)
		staurolite, garnet, muscovite	Garnet (G) Staurolite (S) Muscovite (Ms) Schist (Sch)
	gneissose	plagioclase, hornblende	Amphibolite (Amp) Gneiss (Gns)
		feldspar, quartz	Granitie (Gr) Gneiss (Gns)
		eye-shaped feldspar, mica	Augen (Au) Gneiss (Gns)

Attachment G



Compton, R.R., Manual of Field Geology, 1962.

Attachment H

Abundant - abnt	Diameter – dia	Laminated – lam
Amount – amt	Different – diff	Maximum – max
Approximate – approx	Disseminated – dissem	Pebble – pbl
Arenaceous – aren	Elevation – elev	Phenocryst – phen
Argillaceous – arg	Equivalent – equiv	Porphyritic – proph
Average – ave	foliated – fol	Probable – prob
Bedded – bdd	Formation frm	Quartz – qrz
Bedding – bdg	Fracture – frac	Regular – reg
Calcareous – calc	Fragmental – frag	Rocks – rx
Cemented – cmt	Granular – Gran	Rounded – rnd
Cobble – cbl	Gypsiferous – Gyp	Saturated – sat
Contact – ctc	Horizontal – hriz	Secondary – sec
Cross-bedded - xbdd	Igneous – ign	Siliceous – sil
Cross-bedding – xbdg	Inclusion – incl	Structure – struc
Cross-laminated – xlam	Interbedded – intbdd	Unconformity – uncnf
Crystal – xl	Irregular – ireg	Variegated – vrgt
Crystalline – xln	Joint – jnt	Vein – vn
grain – gn	gradational – grad	poor – pr
fine – f	erosional – er	moderate – mod
very fine – vf	abrupt – ab	well – well
medium – med		
coarse – crs		
large – lg	grain supported – gs	
very large – vlg	matrix supported – ms	
small – sm	imbricate – im	

Adapted from, Compton, R.R., *Manual of Field Geology*, 1962.

Attachment I

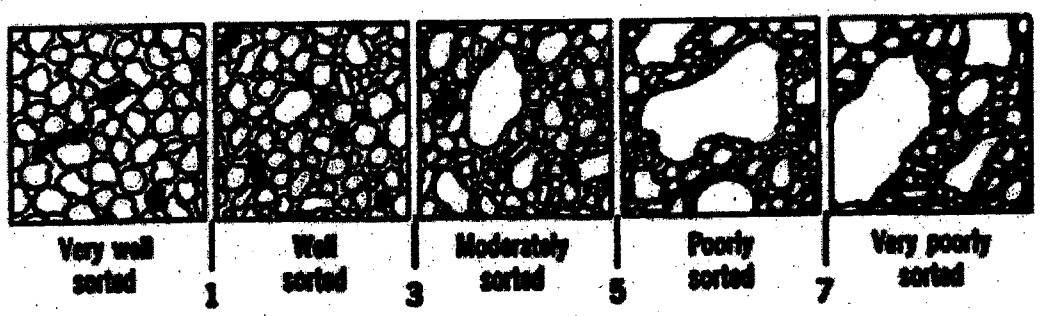
Naming of Unconsolidated Materials

Main Particle	Gravel	Sand	Silt	Clay
> 15 % gravel	Gravel	Gravelly Sand	Gravelly Silt	Gravelly Clay
> 15 % sand	Sandy Gravel	Sand	Sandy Silt	Sandy clay
> 15 % silt	Silty Gravel	Silty Sand	Silt	Silty Clay
> 15 % clay	Clayey Gravel	Clayey Sand	Clayey Silt	Clay
5-15 % gravel	Not Applicable	Sand with Gravel	Silt with Gravel	Clay with Gravel
5-15 % sand	Gravel with sand	Not applicable	Silt with Sand	Clay with sand
5-15 % silt	Gravel with silt	Sand with silt	Not applicable	Clay with silt
5-15 % clay	Gravel with clay	Sand with clay	Silt with clay	Not applicable
> 15% gravel plus 15% sand	Sandy Gravel	Gravelly Sand	Gravelly Sandy Silt	Gravelly Sandy Clay
> 15% gravel plus 15% silt	Silty Gravel	Gravelly Silty Sand	Gravelly Silt	Gravelly Silty Clay
> 15% gravel plus 15% clay	Clayey Gravel	Gravelly Clayey Sand	Gravelly Sandy Silt	Gravelly Clay
> 15% sand plus 15% silt	Silty Sand Gravel	Silty Sand	Sandy Silt	Sandy Silty Clay
> 15% sand plus 15% clay	Sandy Clayey Gravel	Clayey Sand	Sandy Clayey Silt	Sandy Clay
> 15% silt plus 15% clay	Silty Clayey Gravel	Silty Clayey Sand	Clayey Silt	Silty Clay
Note: Other combinations are possible when all particle sizes are present in greater than 15%. For example, a Silty Clayey Gravelly Sand. Other possible combinations exist such as a Gravelly Sand with silt.				

Compton, R.R., *Manual of Field Geology*, 1962.

Attachment J

Sorting Chart



Compton, R.R., Manual of Field Geology, 1962.

Attachment K

Example of Unified Soil Classification System (USCS)

Unified Soil Classification System (USCS)

	MILLIMETERS	INCHES	SIEVE SIZES
BOULDERS	> 300	> 11.8	-
COBBLES	75 - 300	2.9 - 11.8	-
GRAVEL: COARSE	75 - 19	2.9 - .75	-
FINE	19 - 4.8	.75 - .19	3/4" - No. 4
SAND: COARSE	4.8 - 2.0	.19 - .08	No. 4 - No. 10
MEDIUM	2.0 - .43	.08 - .02	No. 10 - No. 40
FINE	.43 - .08	.02 - .003	No. 40 - No. 200
FINES: SILTS	< .08	< .003	< No. 200
CLAYS	< .08	< .003	< No. 200

Attachment K

Example of Unified Soil Classification System (USCS) (Continued)

CLAY

CLAY CONSISTENCY	THUMB PENETRATION	SPT, N BLOWS/ FT.	Undrained Shear Strength c (PSF) TORVANE	Unconfined Compressive Strength q_u Pocket Penetrometer
VERY SOFT	Easily penetrated several inches by thumb. Exudes between thumb and finger's when squeezed in hand.	< 2	250	500
SOFT	Easily penetrated one inch by thumb. Molded by light finger pressure.	2 - 4	250 - 500	500 - 1000
MEDIUM STIFF	Can be penetrated over 1/4 " by thumb with moderate effort. Molded by strong finger pressure.	4 - 8	500 - 1000	1000 - 2000
STIFF	Indented about 1/8" by thumb but penetrated only with great effort.	8 - 15	1000 - 2000	2000 - 4000
VERY STIFF	Readily indented by thumbnail.	15 - 30	2000 - 4000	4000 - 8000
HARD	Indented with difficulty by thumbnail.	> 30	> 4000	> 8000

SAND

SOIL TYPE	SPT, N Blows/ft	Relative Density,%	FIELD TEST
VERY LOOSE SAND	4	0 - 15	Easily penetrated with 1/2" reinforcing rod pushed by hand.
LOOSE SAND	4 - 10	15 - 35	Easily penetrated with 1/2" reinforcing rod pushed by hand.
MEDIUM DENSE SAND	10 - 30	35 - 65	Penetrated a foot with 1/2" reinforcing rod driven with 5-lb hammer.
DENSE SAND	30 - 50	65 - 85	Penetrated a foot with 1/2" reinforcing rod driven with 5-lb hammer.
VERY DENSE SAND	50	85 - 100	Penetrated only a few inches with 1/2" reinforcing rod driven with 5-lb hammer.

Summary of USCS Field Identification Tests

Coarse-Grained Soils **More than half the material (by weight) is individual grains visible to the naked eye**	**Gravelly Soils** More than half of coarse fraction is larger than 4.75 mm		**Clean Gravels** Will not leave a stain on a wet palm	Substantial amounts of all grain particle sizes			GW
				Predominantly one size or range of sizes with some intermediate sizes missing			GP
			Dirty Gravels Will leave a stain on a wet palm	Non-plastic fines (to identify, see ML below)			GM
				Plastic fines (to identify, see CL below)			GC
	Sandy Soils More than half of coarse fraction is smaller than 4.75 mm		**Clean Sands** Will not leave a stain on a wet palm	Wide range in grain size and substantial amounts of all grain particle sizes.			SW
				Predominantly one size or a range of sizes with some intermediate sizes missing			SP
			Dirty Sands Will leave a stain on a wet palm	Non-plastic fines (to identify, see ML below)			SM
				Plastic fines (to identify, see CL below)			SC
Fine-Grained Soils **More than half the material (by weight) is individual grains not visible to the naked eye** **(<0.074 mm)**	**Ribbon**	**Liquid Limit**	**Dry Crushing Strength**	**Dilatancy Reaction**	**Toughness**	**Stickiness**	
	None	<50	None to Slight	Rapid	Low	None	ML
	Weak	<50	Medium to High	None to Very Slow	Medium to High	Medium	CL
	Strong	>50	Slight to Medium	Slow to None	Medium	Low	MH
	Very Strong	>50	High to Very High	None	High	Very High	CH
Highly Organic Soils	Readily identified by color, odor, spongy feel, and frequently by fibrous texture						OL OH Pt

Field Logbook Content and Control

Prepared: Del Baird

Technical Review: Sharon Budney

QA Review: Douglas J. Updike

Approved: Michael C. Mally 2/24/04
Signature/Date

Issued: 2/18/04
Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to set CDM Federal (CDM) criteria for content entry and form of field logbooks. Field logbooks are an essential tool to document field activities for historical and legal purposes.

2.0 Background

2.1 Definitions

Biota - The flora and fauna of a region.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks includes field team names, observations, data, calculations, date/time, weather, and description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain deviations from plans and descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 Responsibilities

Field Team Leader (FTL) - The FTL is responsible for ensuring that the format and content of data entries are in accordance with this procedure.

Site Personnel - All CDM employees who make entries in field logbooks during onsite activities are required to read this procedure prior to engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

4.0 Required Equipment

- Site-specific plans
- Field notebook
- Indelible black or blue ink pen
- Ruler or similar scale

5.0 Procedures

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with all procedures applicable to the field activity being performed. These procedures should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the logbook. Prior to use in the field, each logbook will be marked with a specific document control number issued by the document control administrator, if required by the contract quality implementation plan (QIP). Not all contracts require document control numbers. The following information shall be recorded on the cover of the logbook:

- Field logbook document control number.
- Activity (if the logbook is to be activity-specific) and location.
- Name of CDM contact and phone number(s).
- Start date.
- In specific cases, special logbooks may be required (e.g., waterproof paper for stormwater monitoring).

The first few (approximately five) pages of the logbook will be reserved for a table of contents (TOC). Mark the first page with the heading and enter the following:

Table of Contents

Date/Description	Page
(Start Date)/Reserved for TOC	1-5

The remaining pages of the table of contents will be designated as such with "TOC" written on the top center of each page.

5.2 Operation

Requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information need not be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.

Field Logbook Content and Control

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the logbook by inserting the following:
  Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)
- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
  - Date and time
  - Name of individual making entry
  - Names of field team and other persons onsite
  - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personal protection to be used
  - Serial numbers of instruments
  - Required calibration information
  - Serial/tracking numbers on documentation (e.g., carrier air bills)

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page. Maps, sketches, figures, or data that will not fit on a logbook page should be referenced and attached to the logbook to prevent separation.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.

5.3 Post-Operation

To guard against loss of data due to damage or disappearance of logbooks, completed pages shall be periodically photocopied (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied and submitted regularly and as promptly as possible to the office. When possible, electronic media such as disks and tapes should be copied and forwarded to the project office.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated, and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 Restrictions/Limitations

Field logbooks constitute the official record of onsite technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by CDM personnel and their subcontractors. They are documents that may be used in court to indicate dates, personnel, procedures, and techniques employed during site activities. Entries made in these logbooks should be factual, clear, precise, and non-subjective. Field logbooks, and entries within, are not to be used for personal use.

7.0 References

Sandia National Laboratories, *Procedure for Preparing Sampling and Analysis Plan, Site-Specific Sampling Plan, and Field Operating Procedures*, QA-02-03, Albuquerque Environmental Program Department 3220, Albuquerque, New Mexico, 1991.

Sandia National Laboratories, Division 7723, *Field Operation Procedure for Field Logbook Content and Control, Environmental Restoration Department*, Albuquerque, New Mexico, 1992.

Photographic Documentation of Field Activities

SOP 4-2
Revision: 6
Date: March 1, 2004

Prepared: David O. Johnson
Technical Review: Jo Nell Mullins
QA Review: Laura Splichal
Approved: Michael C. Molly 2/24/04
Signature/Date
Issued: 3/10/04
Signature/Date

1.0 Objective

The purpose of this standard operating procedure (SOP) is to provide standard guidelines and methods for photographic documentation, which include still and digital photography and videotape recordings of field activities and site features (geologic formations, core sections, lithologic samples, water samples, general site layout, etc.). This document shall provide guidelines designed for use by a professional or amateur photographer. This SOP is intended for circumstances when formal photographic documentation is required. Based on project requirements, it may not be applicable for all photographic activities.

2.0 Background

2.1 Definitions

Photographer – A photographer is the camera operator (professional or amateur) of still photography, including digital photography, or videotape recording whose primary function with regard to this SOP is to produce documentary or data-oriented visual media.

Identifier Component – Identifier components are visual components used within a photograph such as visual slates, reference markers, and pointers.

Standard Reference Marker – A standard reference marker is a reference marker that is used to indicate a feature size in the photograph and is a standard length of measure, such as a ruler, meter stick, etc. In limited instances, if a ruled marker is not available or its use is not feasible, it can be a common object of known size placed within the visual field and used for scale.

Slates – Slates are blank white index cards or paper used to present information pertaining to the subject/procedure being photographed. Letters and numbers on the slate will be bold and written with black, indelible marking pens.

Arrows and Pointers – Arrows and pointers are markers/pointers used to indicate and/or draw attention to a special feature within the photograph.

Contrasting Backgrounds – Contrasting backgrounds are backdrops used to lay soil samples, cores, or other objects on for clearer viewing and to delineate features.

Data Recording Camera Back – A data recording camera back is a camera attachment or built-in feature that will record, at the very least, frame numbers and dates directly on the film.

2.2 Discussion

Photographs and videotape recordings made during field investigations are used as an aid in documenting and describing site features, sample collection activities, equipment used, and possible

lithologic interpretation. This SOP is designed to illustrate the format and desired placement of identifier components, such as visual slates, standard reference markers, and pointers. These items shall become an integral part of the "visual media" that, for the purpose of this document, shall encompass still photographs, digital photographs, and videotape recordings (or video footage). The use of a photographic logbook and standardized entry procedures are also outlined. These procedures and guidelines will minimize potential ambiguities that may arise when viewing the visual media and ensure the representative nature of the photographic documentation.

2.3 Associated Procedures

- CDM Federal SOP 4-1, Field Logbook Content and Control

3.0 Responsibilities

Field Team Leader (FTL) – The FTL is responsible for ensuring that the format and content of photographic documentation are in accordance with this procedure. The FTL is responsible for directing the photographer to specific situations, site features, or operations that the photographer will be responsible for documenting.

Photographer – The photographer shall seek direction from the FTL and regularly discuss the visual documentation requirements and schedule. The photographer is responsible for maintaining a logbook per Sections 5.1, 5.2.4, and 5.3.1 of this SOP.

4.0 Required Equipment

The following is a general list of equipment that may be used:

- 35mm camera or disposable single use camera (35mm or panoramic use)
- Digital camera
- Extra batteries for 35mm camera
- Video camera
- Logbook
- Indelible black or blue ink pen
- Standard reference markers
- Slates
- Arrows or pointers
- Contrasting backgrounds
- Medium speed, or multi purpose fine-grain, color, 35 mm negative film or slide film (project dependent)
- Data recording camera back (if available)
- Storage medium for digital camera

5.0 Procedures

5.1 Documentation

A commercially available, bound logbook will be used to log and document photographic activities. Review the CDM Federal SOP 4-1, Field Logbook Content and Control and prepare all supplies needed for logbook entries.

Note: A separate photographic logbook is not required. A portion of the field logbook may be designated as the photographic log and documentation section.

5.1.1 Field - Health and Safety Considerations

There are no hazards that an individual will be exposed to specific to photographic documentation. However, site-specific hazards may arise depending on location or operation. Personal protective equipment used in this operation will be site-specific and dictated through requirements set by the site safety officer, site health and safety plan, and/or prescribed by the CDM Federal Corporate Health and Safety Program. The photographer should contact the site safety officer for health and safety orientation prior to commencing field activities. The site health and safety plan must be read prior to entry to the site, and all individuals must sign the appropriate acknowledgement that this has been done.

The photographer should be aware of any potential physical hazards while photographing the subject (e.g., traffic, low overhead hazard, edge of excavation).

5.2 Operation

5.2.1 General Photographic Activities in the Field

The following sections provide general guidelines that should be followed to visually document field activities and site features using still/digital cameras and video equipment. Listed below are general suggestions that the photographer should consider when performing activities under this SOP:

- The photographer should be prepared to make a variety of shots, from close-up to wide-angle. Many shots will be repetitive in nature or format especially close-up site feature photographs. Consideration should therefore be given to designing a system or technique that will provide a reliable repetition of performance.
- All still film photographs should be made using a medium speed, or multi purpose fine-grain, color negative film in the 35 mm format unless otherwise directed by the FTL.
- It is suggested that Kodak brand "Ektapress Gold Deluxe" film or equivalent be used as the standard film for the still photography requirements of the field activities. This film is stable at room temperature after exposure and will better survive the time lag between exposure and processing. It is suggested that film speed ASA 100 should be used for outdoor photographs in bright sunlight, ASA 200 film should be used in cloudy conditions, and ASA 400 film should be used indoors or for very low-light outdoor photographs.
- No preference of videotape brand or digital storage medium is specified and is left to the discretion of the photographer.
- The lighting for sample and feature photography should be oriented toward a flat condition with little or no shadow. If the ambient lighting conditions are inadequate, the photographer should be prepared to augment the light (perhaps with reflectors or electronic flash) to maintain the desired visual effect.
- Digital cameras have multiple photographic quality settings. A camera that obtains a higher resolution (quality) has a higher number of pixels and will store a fewer number of photographs per digital storage medium.

5.2.2 General Guidelines for Still Photography

Slate Information

When directed by the FTL, each new roll of film or digital storage medium shall contain on the first usable frame (for film) a slate with consecutively assigned control numbers (a consecutive, unique number that is assigned by the photographer as in sample numbers).

Caption Information
All still photographs will have a full caption permanently attached to the back or permanently attached to a photo log sheet. The caption should contain the following information (digital photographs should have a caption added after the photographs are downloaded):

- Film roll control number (if required) and photograph sequence number
- Date and time
- Description of activity/item shown (e.g., name of facility/site, specific project name, project no.)
- Direction (if applicable)
- Photographer

When directed by the FTL, a standard reference marker should be used in all documentary visual media. While the standard reference marker will be predominantly used in close-up feature documentation, inclusion in all scenes should be considered.

Digital media should be downloaded at least once each day.

Close-Up and Feature Photography
When directed by the FTL, close-up photographs should include a standard reference marker of appropriate size as an indication of the feature size and contain a slate marked with the site name and any identifying label, such as a well number or core depth, that clearly communicates to the viewer the specific feature being photographed.

Feature samples, core pieces, and other lithologic media should be photographed as soon as possible after they have been removed from their in situ locations. This enables a more accurate record of their initial condition and color. When directed by the FTL, include a standard reference color strip (color chart such as Munsell Soil Color Chart or that available from Eastman Kodak Co.) within the scene. This is to be included for the benefit of the viewer of the photographic document and serves as a reference aid to the viewer for formal lithologic observations and interpretations.

Site Photography
Site photography, in general, will consist predominantly of medium and wide-angle shots. A standard reference marker should be placed adjacent to the feature or, when this is not possible, within the same focal plane.

While it is encouraged that a standard reference marker and caption/slate be included in the scene, it is understood that situations will arise that preclude their inclusion within the scene. This will be especially true of wide-angle shots. In such a case, the film/tape control number shall be entered in the photographic logbook along with the frame number and all other information pertinent to the scene.

Panoramic
In situations where a wide-angle lens does not provide sufficient subject detail, a single-use disposable panoramic camera is recommended. If this type of camera is not available, a panoramic series of two or three photos would be appropriate. Panoramas can provide greater detail while covering a wide subject, such as an overall shot of a site.

To shoot a panoramic series using a standard 35 mm or digital camera, the following procedure is recommended.

- Use a stable surface or tripod to support the camera
- Allow a 20 to 30 percent overlap while maintaining a uniform horizon
- Complete two to three photos per series

5.2.3 General Photographic Documentation Using Video Cameras

As a reminder, it is not within the scope of this document to set appropriate guidelines for presentation or "show" videotape recording. The following guidelines are set for documentary videotape recordings only and should be implemented at the discretion of the FTL.

Documentary videotape recordings of field activities may include an audio slate for all scenes. At the beginning of each video session, an announcer will recite the following information: date, time (in military units), photographer, site ID number, and site location. This oral account may include any additional information clarifying the subject matter being recorded.

A standard reference marker may be used when taking close-up shots of site features with a video camera. The scene may also include a caption/slate. It should be placed adjacent and parallel to the feature being photographed.

It is recommended that a standard reference marker and caption/slate be included in all scenes. The caption information is vital to the value of the documentary visual media and should be included. If it is not included within the scene, it should be placed before the scene.

Original videotape recordings will not be edited. This will maintain the integrity of the information contained on the videotape. If editing is desired, a working copy of the original videotape recording can be made.

A label should be placed on the videotape with the appropriate identifying information (i.e., project name, project number, date, location, etc.).

5.2.4 Photographic Documentation

Photographic activities must be documented in a photographic logbook or in a section of the field logbook. The photographer will be responsible for making proper entries.

In addition to following the technical standards for logbook entry as referenced in CDM Federal SOP 4-1, the following information should be maintained in the appropriate logbook:

- Photographer name.
- If required, an entry shall be made for each new roll/tape control number assigned.
- Sequential tracking number for each photograph taken (for digital cameras, the camera-generated number may be used).
- Date and time (military time).
- Location.
- A description of the activity/item photographed.

- If needed, a description of the general setup, including approximate distance between the camera and the subject, may be recorded in the logbook.
- Record as much other information as possible to assist in the identification of the photographic document.

5.3 Post Operation

All film will be sent for development and printing to a photographic laboratory (to be determined by the photographer). The photographer will be responsible for arranging transport of the film from the field to the photographic laboratory. The photographer shall also be responsible for arranging delivery of the negatives and photographs, digital storage medium, or videotape to the project management representative.

5.3.1 Documentation

At the end of each day's photographic session, the photographer(s) will ensure that the appropriate logbook has been completely filled out and maintained as outlined in CDM Federal SOP 4-1.

5.3.2 Archive Procedures

1. Photographs and the associated set of uncut negatives, digital media, and original unedited documentary videotape recordings will be submitted to the project files and handled according to contract records requirements. The FTL will ensure their proper distribution.

2. Completed pages of the appropriate logbook will be copied weekly and submitted to the project files.

6.0 Restrictions/Limitations

This document is designed to provide a set of guidelines for the field amateur or professional photographer to ensure that an effective and standardized program of visual documentation is maintained.

It is not within the scope of this document to provide instruction in photographic procedures, nor is it within the scope of this document to set guidelines for presentation or "show" photography.

The procedures outlined herein are general by nature. The FTL is responsible for specific operational activity or procedure. Questions concerning specific procedures or requirements should be directed to the FTL.

Note: Some sites do not permit photographic documentation. Check with the site contact for any restrictions.

7.0 References

U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3*, February 2001, Appendix F.

U.S. Environmental Protection Agency, Region IV, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Athens, Georgia, November 2001.

U.S. Environmental Protection Agency, National Enforcement Investigations Center, *Multi-Media Investigation Manual*, EPA-330/9-89-003-R, Revised March 1992, p. 85.

Field Sampling Plan
APPENDIX C

Activity Hazard Analysis (AHA) for the Vineland Chemical Superfund Site Health and Safety Plan (HASP)

ACTIVITY HAZARD ANALYSIS

[1] AHA No. 3223-159-01	
[2] Work Location: Cumberland County, Vineland, New Jersey	
[3] Task Title: Drilling, geoprobe, hand augering (powered or manual) soil boring, soil sampling collection, decontamination of equipment and removal of trees in a designated wetland area.	
[4] Work Phase: Remedial Investigation/Feasibility Study (RI/FS)	**[5] List Work Groups Needed for Each Phase**
A. Soil sample collection and decontamination of the equipment in a wetland.	**A.** Drillers, Environmental Scientist, and Geologists
B. Soil sample collection and decontamination of the equipment in a wetland	**B.** Environmental Scientists, and Geologists
C. Removal of trees using a chainsaw in the wetland	**C.** Drillers, Geologists, Environmental Scientists
This AHA shall be reviewed annually or as requested by the workers, supervisors, and /or safety representative	

[6] Activity Steps	**[7] Work Groups**	**[8] Hazards**	**[9] Hazard Controls (Engineered, Operational Documents, PPE, Qualifications)**
Drilling, geoprobe, hand augering (powered or manual and soil boring in a wetland	Drillers, Environmental, Scientists, and Geologists	Contamination	• Plastic sheeting will be placed under the working end of the rig and the area to be drilled. Because the work will be preformed in a wetland area, the plastic sheeting will be trimmed approriately and maintained so that it does not present a slip hazard to workers. If conditions are such that the plastic presents a slip hazard, it will not be used. • If fuel or oil leak onto the plastic sheeting, absorbent pads will be used to recover the oil.

ACTIVITY HAZARD ANALYSIS

[6] Activity Steps	[7] Work Groups	[8] Hazards	[9] Hazard Controls (Engineered, Operational Documents, PPE, Qualifications)
Drilling, geoprobe, hand augering (powered or manual) and soil boring in a wetland (continued)	Drillers, Environmental, Scientists, and Geologists	Housekeeping - slips/trips/falls	• All sites will be kept clean and free of trash and other debris. • All trash will be properly containerized and removed or staged daily. • Electrical Cords will be maintained above any wet surface. • Equipment will be stored when not in use. • All personnel will wear rubber boots or boot covers to mitigate slippery conditions in wetland.
		Equipment inspection	• Prior to use all drill rigs and related equipment will be inspected by health and safety and the STR or designate. • Drill rigs and support equipment will be inspected daily and documented by the equipment operator.
		Drill rig failure	• The mast and cables must be able to support all equipment and drill rods. • Wire cables must be maintained in good condition, free from kinks or broken strands. • All rotating shafts, pulleys or chains must be covered with protective guards. • All drill rigs must have an emergency kill switch, which is readily accessible to personnel at the rear of the rig. All personnel on the site will know the location of the kill switch and how to use it.
		Water tanks	• All water tanks must be securely fastened to the truck frame. • Water tanks should be constructed of materials with adequate side strength, baffled to prevent the sloshing of water side to side, and must have lids with gaskets to prevent water loss.

ACTIVITY HAZARD ANALYSIS

[6] Activity Steps	[7] Work Groups	[8] Hazards	[9] Hazard Controls (Engineered, Operational Documents, PPE, Qualifications)
Drilling, geoprobe, hand augering (powered or manual) and soil boring in a wetland (continued)	Drillers, Environmental, Scientists, and Geologists	Back Injuries	• Employees will use proper lifting techniques: Bend at knees and grip object with whole hand, keep back as straight and vertical as possible, center body weight over feet, arms and elbows kept close to the body • Heavy or large objects shall be carried by two people • Ensure pathways are clear before moving heavy objects
		Rig/equipment damage	• Wire cables will be inspected daily. Cables with broken strands, weak spots, kinking, or mashed areas will be replaced prior to use.
		Fire prevention	• Drill rigs will contain at least on ABC type fire extinguisher. • Fire extinguishers will be fully charged and inspected weekly. • Fuels will be stored in appropriate containers.
		Severe weather	• Drilling will stop when rain or snow interferes with the safety of the operators. • Drilling activities will stop during lightning. • Operators, crew, and other support personnel will move out of the exclusion zone and take shelter in other vehicles.
		Cathead hazards	• The operator must be trained and experienced in the use of a cathead. • The rope must be in good condition. • The operator shall not wear loose clothing.

ACTIVITY HAZARD ANALYSIS

[6] Activity Steps	[7] Work Groups	[8] Hazards	[9] Hazard Controls (Engineered, Operational Documents, PPE, Qualifications)
Drilling, geoprobe, hand augering (powered or manual) and soil boring in a wetland (continued)	Drillers, Environmental, Scientists, and Geologists	Power lines/underground utilities	• Ensure that there are no power lines or underground utilities present before drilling. • If work is near an overhead line, care will be taken to ensure there is sufficient clearance when raising the mast. • While working near power lines, drill rods will not be leaned against the mast. • If the drill bit encounters anything hard, drilling will stop and the Geologist will be notified immediately.
Decontamination Using Steam Cleaner a steam cleaner	Drillers	Hand injury	• Skid mounted steam cleaners will have protective guarding on all rotating shafts, belts, and pulleys. • Nitrile gloves will be worn while operating the steam cleaner. • Keep hands clear of the water spray.
		Hearing loss	• Hearing protection will be worn during steam cleaning operation as determined by the Site Health and Safety Officer.
		Eye protection	• The operator and assistants will wear face shields during steam cleaning.
		Fire	• Turn off the steam cleaner and allow it to cool before refueling. • Generators will be turned off while being refueled. • Smoking is prohibited during refueling operation.
		Electrical	• If steam cleaners are being powered by a generator, a Ground-Fault Circuit Interrupter (GFCI) will be required. • Electrical cords will be maintained above wet surfaces.

ACTIVITY HAZARD ANALYSIS

[6] Activity Steps	[7] Work Groups	[8] Hazards	[9] Hazard Controls (Engineered, Operational Documents, PPE, Qualifications)
Soil Sampling	Environmental Scientists and Geologists	Contamination	• At a minimum, Plastic sheeting will be placed over the area to be sampled. If the contaminates warrant, plastic sheeting will be placed under the generator. • If fuel or oil leaks on the plastic sheeting, absorbent pads will be used.
		Housekeeping - Slips/trips/falls	• All sites will be kept clean and free of trash and other debris. • All trash will be properly containerized and removed or staged daily. • All personnel will wear rubber boots or boot covers to mitigate the slippery condition in the wetland.
		Overhead hazards: dead/dying trees in the wetland area	• Prior to the sampling event, hazardous trees, as many as possible, will be removed from the area. • Hard hats will be worn at all times.
		Inhalation hazard	• A MultiRae will be used during sampling to monitor breathing zone.
		Eye Injury	• Safety glasses will be required during sampling.
		Foot injury	• Leather steel-toes boots will be required.
		Hand injury	• Two layers of disposable latex or nitrile gloves will be worn during routine sampling activities. • Cotton gloves may be worn under disposable gloves to protect from cold. • Keep hands away from all moving parts of machinery.
		Unauthorized operation	• Only trained and authorized personnel will operated and/or assist in sampling operations.

ACTIVITY HAZARD ANALYSIS

[6] Activity Steps	[7] Work Groups	[8] Hazards	[9] Hazard Controls (Engineered, Operational Documents, PPE, Qualifications)
Soil Sampling (Continued)	Environmental Scientist and Geologists	Slips/trips	• Slippery conditions will be avoided. Samplers will wear rubber boots or boot covers to mitigate slippery conditions in the wetland.
		Biological Hazards	• See Sevenson's SHASP, page 15
		Fire prevention	• Vehicles will contain at least one ABC type fire extinguisher. • Fire extinguishers will be fully charged and inspected weekly. • Fuels will be stored in appropriate containers.
		Severe weather	• Sampling will stop when rain interferes with the safety of the operators. • Sampling activities will stop during lightning.
Decontamination of Sampling Equipment	Environmental Scientists and Geologists	Hand injury	• 12 mil nitrile gloves will be worn during decontamination processes.
		Eye injury	• Safety glass will be worn during the decontamination process.
		Chemical spills	• Contain spill and use proper procedures to clean and dispose of chemicals. • Change gloves frequently to avoid skin contact with chemicals.
		Eye injury	• Safety glass will be required during decontamination.
Removal of trees/brush with chainsaw	Drillers, Environmental Scientist, and Geologists	Hand injury	• Leather work gloves and protective leg chaps are to be worn by the chainsaw operator. • Tree removal will conform with USACE EM-385-1-1
		Fall protection	• See Sevenson's SHASP, page 13

ACTIVITY HAZARD ANALYSIS

[6] Activity Steps	[7] Work Groups	[8] Hazards	[9] Hazard Controls (Engineered, Operational Documents, PPE, Qualifications)
Removal of trees/brush with chainsaw (continued)	Drillers, Environmental Scientist, and Geologists	Power tools	• See Sevenson's SHASP, page 12
		Eye/Face injury	• Faceshields and hardhats are to be worn by chainsaw operator. • Hardhats and safety glasses are to be worn by all other personnel

[10] Attachments:

Document Type	Document Number	Applies to Work Group	For Work Step(s)/Phase(s)
Comments:			

[11] References:

Document Type	Document Number	Applies to Work Group	For Work Step(s)/Phase(s)
CDM Federal's Health and Safety Program Manual	NA (dated August 2000)	All	All
Sevenson's Site Health and Safety Plan	NA (dated September 2003)	All	All

[12] Subcontractor Approvals		a. Print Name	b. Signature	c. Date
1	Environmental , Safety, and Health	Chuck Myers	Chuck J. Myers	01/20/05
2	Site Supervisor			

ACTIVITY HAZARD ANALYSIS

[13] Change Summary			
[6] Activity Steps	**[7] Work Groups**	**[8] Hazards**	**[9] Hazard Controls (Engineered, Operational, Documents, PPE Qualification)**

[14] Subcontractor Approvals		a. Print Name	b. Signature	c. Date
1	Environmental, Safety and Healthy			
2	Site Supervisor			

ACTIVITY HAZARD ANALYSIS

PRE-JOB BRIEFING ATTENDANCE

AHA No.: 3223-159-01	Job Title: AHA for All Tasks	Date:
Service Supervisor	Performer Organization:	Time:
I agree to work within the scope of work and follow the work controls described in the briefing.		

Signature	Badge No. Or SSN	Organization

US ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
LEADERS IN CUSTOMER CARE

FINAL QUALITY ASSURANCE PROJECT PLAN

Operable Unit 3
Blackwater Branch Investigation
Vineland Chemical Superfund Site
Vineland, New Jersey

USACE CONTRACT NO. DACW 41-02-D-0002
TASK ORDER NO. CF02

January 2005

Prepared by:

CDM Federal Programs Corporation
Raritan Plaza I, Raritan Center
Edison, NJ 08818

CDM

Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Section 1
Introduction

1.1 Plan Objectives

This portion of the Sampling and Analysis Plan (SAP) presents the Quality Assurance Project Plan (QAPP) for the activities to be performed during work at the Vineland Chemical Company Superfund Site (the Site), located in Vineland, New Jersey. The purpose of this QAPP is to provide guidance on meeting Data Quality Objectives (DQOs), therefore, producing analytical data of known and documented quality. The QAPP also indicates the prime responsibility of CDM and the contract laboratories in conducting the investigation and described the policy, organization and specify quality assurance (QA) and quality control (QC) elements necessary to achieve the DQOs in accordance with Federal and State regulations and requirements. The Field Sampling Plan (FSP), which is also part of this SAP, sets forth the sampling procedures, preservation for the samples collected in the field, field documentation, and sample packaging and shipping. The FSP and QAPP are integrated and cross-referenced where applicable to avoid redundancy.

This QAPP is prepared in accordance with United States Environmental Protection Agency (EPA) and United States Army Corps of Engineers (USACE) guidance documents: *Requirements for the Preparation of Sampling and Analysis Plans* (USACE EM200-1-3, 2001), *Chemical Quality Assurance for HTRW Projects* (USACE EM200-1-6, 1997), and *Guidance Objectives for the Data Quality Objectives Process (EPA QA/G-4,* August 2000). This QAPP has been prepared to support sampling efforts for the Operable Unit (OU) 3 area of the Site.

The following elements will be addressed in this QAPP. These elements are as follows:

- Project descriptions and scope
- Contract laboratory organization and responsibility
- The DQOs specific to the site and sampling event
- Analytical methods/quality assurance summary tables
- Holding time requirements
- A detailed description of all calibration and prevention maintenance procedures for all field and laboratory analytical instrumentation
- A detailed description of the chain-of-custody procedures to be utilized in the laboratory
- A detailed descriptions of sample storage procedures to be utilized by the laboratory
- Laboratory data reporting requirements
- Automated Data Review (ADR) requirements

These elements are addressed in the following Sections 2 through 7 and associated tables.

Analytical laboratories to be utilized shall hold a current USACE, and New Jersey Department of Environmental Protection (NJDEP) certification prior to the sampling event and will be required to adhere to the provision of this QAPP.

1.2 Site History and Contaminants

A description of the site history and contaminants identified at the Site is provided in Section 1.1 of the FSP.

1.3 Site Specific Sampling

The FSP contains the details of the project scope and objectives, sampling design, procedures, methods, and rationales. The anticipated sampling frequency, number of samples, frequency of QC samples, and types of analysis are also found in the FSP.

Section 2
Project Organization and Responsibilities

CDM is the designated USACE contractor responsible for conducting the activities required by the current task order, including soil borings and sample collection. CDM project organization, with respect to chemical quality control management, is discussed in Section 2 of the FSP and is shown in the organizational chart in Figure 2-1 of the FSP. The CDM ASC will be responsible for the ADR/EDMS aspects of the project. The functional responsibilities of key laboratory personnel for CDM's contract laboratory are described in the following subsections.

2.1 Subcontracted Laboratory

Analytical laboratory support specific to the Site sampling activities will be obtained from Mitkem Corporation. Mitkem Corporation is an USACE, NJDEP, and National Environmental Laboratory Accreditation Conference (NELAC) approved laboratory for analysis of the required parameters for this project investigations. As previous discussed in Section 1.0 of this QAPP, the subcontractor laboratory will be required to adhere to the provision of this QAPP.

An Organizational chart outlining the key laboratory personnel and organization is included as Figure 2-1. Prior to commencement of field activities for the project, a complete copy of the SAP, including this QAPP, will be sent to the laboratory. The responsibilities of key personnel are described in the following paragraphs.

2.1.1 Laboratory Quality Assurance/Quality Control Director

The subcontract laboratory QA/QC Director is responsible for the laboratory QA/QC in accordance with the requirements of this QAPP in conjunction with the established QA Program. In coordination with the CDM Analytical Service Coordinator (ASC), this individual will be responsible for documenting the following:

- Samples received by the laboratory are analyzed in accordance with required methodologies
- Instrument calibration is performed properly and documented
- Field and internal laboratory QC samples are analyzed and documented
- All analytical results for both field and QC samples are reported to the project in the format required by the laboratory scope of work and QAPP
- Processing laboratory non-conformance report (NCR) and for implementing corrective action report recommendations and requirements

2.1.2 Laboratory Project Manager

The responsibilities of the Laboratory Project Manager include the following:

- Initiation and maintenance of contact with the project on individual job tasks
- Preparation of all laboratory-associated work plans, schedules, and manpower allocations

- Initiation of laboratory associated procurement for the project
- Provision of day-to-day direction of the laboratory project team including analytical department managers, supervisors, QA personnel, and data management personnel
- Coordination of all laboratory related financial and contractual aspects of the project
- Provision of formatting and technical review for all laboratory reports
- Provision of final review and approval on all laboratory analytical reports to the project
- Response to all post project inquiries

2.1.3 Laboratory Operations Manager

The responsibilities of the Operations Manager include the following:

- Coordination with all analytical production activities conducted within the analytical departments
- Working with the Laboratory Operations Manager to ensure all project objectives are met
- Provision of guidance to analytical department managers
- Facilitation of transfer of data produced by the analytical departments to the report preparation and review staff for final delivery to the client

2.1.4 Laboratory Section Heads, Department Managers, and Technical Leads

The responsibilities of each laboratory section heads, department managers or technical leads include the following:

- Coordination of all analytical functions related to specific analytical areas
- Provision of technical information to and oversight of all analysis being performed
- Review and approve all analytical results produced by their specific analytical area of expertise
- Maintenance of all analytical records and information pertaining to the analysis being performed

The laboratory shall be staffed by analytical professionals exhibiting the qualifications defined in Section 1.4 of Appendix I of USACE EM200-1-3.

2.1.5 Management Information System

The responsibilities of the management information system (MIS) are to maintain and support the Laboratory Information Management System (LIMS), to optimize the electronic transfer of laboratory data and to maintain system hardware and software. Hand entry of sample information and data are kept to a minimum in order to control errors arising from transcription. The basic aspects of Mitkem's LIMS system are as follows:

- All samples received are assigned tests according to their corresponding chain of custody information. Each sample is assigned a unique laboratory identification number. The LIMS automatically schedules the samples for analysis according to turn around and holding time priorities
- Analyst can then download sample information to set up their analytical runs
- After analysis result data is transferred to the LIMS system and compiles with other data associated with any particular sample
- Sample status can be obtained at any point in the process
- Once data is reviewed and accepted reports can be generated in as summary tables, CLP deliverable or any number of formats
- The LIMS also supports generation of EDDs in many pre-programmed and project specific formats such as ADAPT, NJ-HAZSITE, GISKEY and ADR
- Upon completion of a project electronic files and a pdf version of hardcopy reports are backed-up on HP Sure-Store 125ex multidisk system for long term storage

CDM's ASC is responsible for the ADR/EDMS aspects of the project and will be working in conjunction with Mitkem's MIS team to produce the ADR library and coordinate laboratory EDD verification.

2.2. Points of Contact

The primary CDM project contacts are presented in the FSP Section 2. The laboratory point of contact for general laboratory questions is Edward Lawler the operations manager. The point of contact for LIMS and ADR concerns is Andy Nelson. Both parties can be reached through the Mitkem switchboard (401) 732-3400.

Section 3
Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of data required to support decisions made during investigation activities, and are based on the end use of the data being collected.

3.1 Project Objectives

The overall project objective is to delineate the horizontal/vertical arsenic contamination in the floodplain area (OU-3) along the Blackwater Branch of the Site and to evaluate the impact of the groundwater treatment system on the arsenic concentrations within the Blackwater Branch. The project will implement procedures for field sampling, chain-of-custody (COC), laboratory analysis and reporting, which will provide information for site evaluation, assessment and remediation. Data must be technically sound and defensible. Procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of field equipment and corrective action are described in other sections of this QAPP.

General analytical objectives are:

- To provide data of sufficient quality and quantity to support ongoing cleanup activities
- To provide data of sufficient quality to meet applicable State of New Jersey and Federal concerns
- To ensure samples are collected using approved techniques and are representative of existing site conditions
- To utilize QA/QC procedures for laboratory methods that meet USACE and other applicable guidance document requirements

Site-specific sampling objectives are as follows:

- Delineate arsenic contamination to establish the excavation limits by collecting sediment samples as detailed in the FSP. Sediment samples will be analyzed for arsenic (all samples) and grain size (10% of samples)
- Perform Toxicity Characteristic Leaching Procedure (TCLP) analysis (arsenic only) on sediment samples to evaluate the disposal facility requirements
- Ensure that the laboratory analytical detection and reporting limits are below the applicable site criteria, as defined by the USACE SOW, specifically below the EPA cleanup criteria of 20 mg/kg for total arsenic and below the RCRA TCLP criteria of 5 mg/L for total arsenic (as reflected in Table 3-3).

3.2 Data Quality Objectives Process

As part of the evaluation component of the Quality Assurance (QA) program, analytical results will be compared to appropriate Data Quality Indicators (DQIs) that are part of the overall DQOs for the project. Sediment sampling will be performed at specific locations presented in the FSP. Table 3-1 presents the number of samples, analytical methods, sample preservation, analytical holding times, and sample container/size requirements for the laboratory. Table 3-2 presents the number of Quality Assurance/Quality Control (QA/QC) samples.

The DQO process is a seven-step planning approach to develop sampling designs for data collection activities that support decision-making. The process uses systematic planning and in some cases, statistical hypothesis testing to differentiate between two or more clearly defined alternatives. DQOs are qualitative and quantitative statements, developed using the DQO Process, that clarify objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. DQOs define the performance criteria that limit the probabilities of making decision errors by considering the purpose of collecting the data; defining the appropriate type of data needed; and specifying tolerable probabilities of making decision errors.

The seven step DQO process is as follows:

- Step 1. "State the Problem" –The problem is presented in Section 1.1 of the FSP. The improper storage of by-product arsenic salts led to arsenic contamination of nearby surface waters and sediments, including the sediments in and around the Blackwater Branch, a tributary of the Maurice River.
- Step 2. "Identify the Decision" - To determine if sediment samples contain arsenic contamination above the project criteria.
- Step 3. "Identify the Inputs to the Decision" – The inputs to the decision include the analytical results from the sediment samples collected during the field investigation. The sediment samples are described in detail in the FSP.
- Step 4. "Define the Boundaries of the Study - The sediment sampling area is bounded by the area of the Blackwater Branch presented in Figure 3-1 of the FSP.
- Step 5. "Develop a Decision Rule - Determine if analytical data results exceed the EPA project-specific cleanup objectives presented in Table 3-3.
- Step 6. "Specify Tolerable Limits on Decision Errors" - The Precision, Accuracy, Sensitivity, and Completeness criteria for the project are presented in Table 3-4, and are further discussed in Section 3.3.
- Step 7. "Optimize the Design for Obtaining Data" - The analytical design for the project will be in accordance with this SAP. The USACE has determined the number of samples that will be collected to support sediment characterization (Tables 3-1 and 3-2).

3.3 Quality Assurance Objectives for Measurement Data

An analytical DQI summary for these investigations is presented in Table 3-4. The laboratory analytical standard operating procedures (SOPs) must comply with Table 3-4. Laboratory selected for this project will be asked to submit all laboratory method SOPs and references, and the actual method detection limit to be achieved for all analysis.

As per USACE EM 200-1-6, a definitive level data will be required for this project. A definitive level of data quality indicates that the analytical test will be performed at an off-site laboratory by instrumentation capable of giving a quantifiable data result. For this level of data for the project, all samples will be shipped for analysis at a USACE-approved laboratory. Data generated at this level is subject to quality assurance and control procedures that include the collection and analysis of QA/QC samples, which are discussed in Section 5.3.2. Definitive quality data will be acquired, documented, verified, and reported to ensure that the specified precision, accuracy, representativeness, comparability, completeness, and sensitivity requirements are met.

3.3.1 Level of Quality Control Effort

To assess whether QA objectives have been achieved, analyses of specific field and laboratory QC samples will be required. These QC samples include rinsate blanks, field duplicates, laboratory method blanks, laboratory control samples, laboratory duplicates, and matrix spike samples.

Rinsate blanks will be submitted for analysis along with field duplicate samples to provide a means to assess the quality of the data resulting from the field sampling program. Rinsate blanks are used to assess the effectiveness of field decontamination process. Criteria and evaluation of blank determinations are provided in Table 3-4 and Section 7.4 of this QAPP. Field duplicate samples are analyzed to determine sample heterogeneity and sampling methodology reproducibility.

Laboratory method blanks and laboratory control samples are employed to determine the accuracy and precision of the analytical method implemented by the laboratory. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology.

The general level of QC effort will be at least one field duplicate for every twenty investigative sediment samples for arsenic analysis only. No field duplicate samples will be collected for grain size analysis.

Matrix spike samples are investigative samples. Soil matrix spike samples require no extra volume for metals analysis. Aqueous matrix spike samples will be collected at triple the volume of metal parameters. One matrix spike sample will be designated in the field and collected for at least every 20 investigative samples per matrix.
The goal is to provide a level of QC effort in conformance with the Standard Methods, such as EPA SW-846 protocols, American Society of Testing and Materials (ASTM) protocols, and National Institute for Occupational Safety and Health (NIOSH) protocols. The QC effort for in-field measurements (organic vapor concentrations) will

include daily calibration of instruments using traceable standards and documented instrument manufacturer procedures. Field instruments and their method of calibration are discussed further in Section 5.2.1 of this QAPP.

3.3.2 Accuracy, Precision, and Sensitivity of Analysis

The fundamental QA objectives for accuracy, precision, and sensitivity of laboratory analytical data are the QC acceptance criteria of the analytical protocols. The accuracy, precision, and sensitivity required for the specified analytical parameters are incorporated in Table 3-4 and are consistent with SW-846 analytical protocols and USACE Shell (USACE EM200-1-3, Appendix I) requirements.

Analytical accuracy is expressed as the percent recovery of an analyte that has been added to a blank sample or environmental sample at a known concentration before analysis. Accuracy will be determined in the laboratory through the use of matrix spike and laboratory control sample analyses. The percent recoveries for specific target analytes will be calculated and used as an indication of the accuracy of the analyses performed.

Precision will be determined by comparing the positive duplicate pair responses. The relative percent difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

Sample collection precision will be measured in the laboratory by the analyses of field duplicates. Precision will be reported as the RPD for two measurements.

3.3.3 Completeness, Representative, and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. It is expected that laboratories will provide data meeting QC acceptance criteria for all samples tested. Overall project completeness goals are identified in Table 3-4.

Representativeness express the degree to which data accurately and precisely present a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that depends upon the proper design of the sampling program and proper laboratory protocol. The rational of the sampling design is discussed in detail in the FSP.

Representativeness will be satisfied by ensuring that the SAP is followed, proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded. Representativeness will determine by assessing the combined aspects of the QA program, QC measures, and data evaluation.

Comparability expresses the confidence with which one data set can be compared with another. The environmental data for the site will be generated in a way that assures comparability. Standardized sampling and analytical procedures will be used. Data will be reported in standardized formats using consistent units of measurements.

Section 4
Sample Receipt, Custody and Holding Times

It is the intent of this investigation to follow EPA policy regarding sample custody and COC protocols as described in National Enforcement Investigation Center (NEIC) Policies and Procedures (May 1986) as well as CDM's TSOPs presented in Appendix B of the FSP. This custody is in three parts: sample collection, laboratory analysis, and final evidence files. Final evidence files, including original of laboratory reports and electronic files, are maintained under document control in a secure area. A sample or evidence file is under your custody when it is:

- In your possession, or
- In your view, after being in your possession, or
- In your possession and you place them in a secured location, or
- In a designated secure area.

Sample custody will begin in the field with proper and correct sample labeling, COC documentation and seals, and air bills (if shipped by common carrier). Specifics of field related custody requirements are presented in Section 5.6 of the FSP.

4.1 Laboratory Custody Procedures

Laboratory custody procedures requirements will be described in the laboratory QA plan. These documents will identify the laboratory custody procedures for sample receipt and log-in, sample storage, tracking during sample preparation and analysis, and laboratory storage of data.

4.1.1 Cooler Receipt Checklist

The condition of shipping coolers and enclosed sample containers will be documented upon receipt at the analytical laboratory. This documentation will be accomplished using the cooler receipt checklist included in the laboratory QA plan. A copy of the checklist will be faxed to the ASC immediately after it has been completed by the laboratory. The original completed checklist will be transmitted with the final analytical results from the laboratory.

4.1.2 Letter of Receipt

The laboratory will confirm sample receipt and log-in information through transmission of a letter of receipt to CDM. This will include returning a copy of the completed COC, a copy of the cooler receipt checklist, and confirmation of the analytical log-in indicating laboratory sample and sample delivery group numbers. These forms will be provided to CDM and the USACE Project Chemist, Erika McCormick (Erika.f.mccormick@usace.army.mil) on a daily basis.

4.2 Final Evidence Files Custody Procedure

The Project Manager is the custodian of the evidence file and will maintain the contents of evidence files for this investigation, including all relevant records, reports, logs, field notebooks, pictures, correspondence, and COC forms. The evidence file will be stored in a secure, limited access area and under custody of the Project Manager.

4.3 Holding Times

Sample holding time for soil and aqueous samples for arsenic analysis is 180 days to extraction/analysis including TCLP samples. Grain size analysis has no holding time requirements.

Section 5
Analytical Procedures

All samples collected during the investigation activities will be analyzed by laboratories approved by USACE. Laboratories will also be currently certified for environmental analyses by the NJDEP. Each laboratory supporting this work will provide statements of qualifications including organizational structure, QA Manual, and SOPs.

5.1 Laboratory Analysis

Samples collected during the project will be analyzed by EPA SW-846 methods for arsenic and ASTM method for grain size. Laboratory standard operating procedures are based on the methods as published by EPA in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846*, Third Edition Final Updates, I, II, IIA, IIB, revised May 1997 for arsenic analysis (method 6010B) and ASTM Standard Method for Particle-Size Analysis of Soils (ASTM D 422-63, reapproved 2002). Analytical parameters, methods, project reporting levels, and laboratory-specific precision and accuracy are listed in Table 3-1.

Principal laboratory will not subcontract or transfer any portion of this work to another facility, unless expressly permitted to do so in writing by CDM Project Manager and USACE Project Manager.

If contaminant concentrations are high, or for matrices other than normal sediment and waters, standard analytical protocols may be inadequate. In these cases, sample analysis may require modifications to defined methodology. Any proposed changes to analytical methods specified require written approval from CDM and USACE. All analytical method variations will be defined in investigation-specific addenda. These may be submitted for regulatory review and approval when directed by the USACE Project Manager.

These SOPs must be adopted from and reference standard EPA SW-846 methods or appropriate national standard and thereby specify:

- Procedures for sample preparation
- Instrument start-up and performance check
- Procedures to establish the actual and required detection limits for each parameter
- Initial and continuing calibration check requirements
- Specific methods for each sample matrix type
- Required analyses and QC requirements

5.2 Calibration Procedures and Frequency

This section describes procedures for maintaining the accuracy of the instruments and measuring equipment that are used for conducting field tests and laboratory analyses. These instruments and equipment shall be calibrated prior to each use or on a scheduled, periodic basis according to manufacturer instructions.

5.2.1 Field Instrument/Equipment

5.2.1.1 Instrument Equipment Testing, Inspection, and Maintenance Requirements

The CDM Quality Procedure (QP) 2.1, "Procuring Measurement and Test Equipment" will be followed by the project personnel when purchasing or renting equipment that will collect site data and field measurements. This process includes the completion of Measurement and Test Equipment (M&TE) forms which include specifications related to meeting project objectives and requirements for calibration. Tables 5-1 and 5-2 include information regarding the calibrated instrument range and specifications of field measurement equipment required for the project. This information will be used when completing the M&TE forms.

Table 5-2 includes requirements for maintenance as well as calibration of field equipment. The staff will obtain spare replacement parts as required for the various equipment as well as appropriate calibration standards. One "Equipment Calibration Log" as shown in Figure 5-1 will be used for each piece of field measurement equipment which will be traceable by serial number. This form will be completed daily or as specified on Table 5-2, Equipment Calibration. The "Equipment Calibration Log" will be used two ways. It will be completed during the initial calibration or field check of each instrument to provide detailed information regarding the calibration procedure. The Field Team Leader (FTL) or designee will check that the forms daily to see if they have been completed correctly. Secondly, it will be used to document any maintenance performed on an instrument. These forms will be maintained in the project files and referred to by project staff.

5.2.1.2 Instrument Calibration and Frequency

Each piece of field equipment used for measuring or monitoring purposes is calibrated and maintained periodically to assure its accuracy within specified limits. General equipment handling and calibration procedures are detailed in the manufacturer's manuals. A copy of these manuals will be on site at all times. Field equipment to be used at the site that requires calibration and/or maintenance is listed in Tables 5-1 and 5-2.

If the calibration schedule is not adequately maintained or accuracy as reported in the specifications cannot be attained, the instrument is labeled "HOLD" and is unavailable for use until the specifications are attained. The field team should not accept instruments labeled "HOLD" or instruments that are out of the maintenance requirements as specified in the manufacturer's manual and Table 5-2.

The field team will be required to calibrate or field check the field equipment per the users' manual and Table 5-2. Information related to the field calibration will be noted in the field logbook. This information will include, at a minimum, the instrument identification number, date and time of calibration, the calibration standard and its source, the person performing calibration, adjustments made, any problems noted during calibration, and a record of calibration measurements. This information will be tracked on Figure 5-1, "Equipment Calibration Log."

5.2.2 Laboratory Instruments

Calibration of laboratory equipment will be based on approved written procedures. Records of calibration, repairs, or replacement will be filed and maintained by laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audit. Procedures and records of calibration will follow USACE reviewed laboratory-specific QA Plans.

In all cases where analyses are conducted according to SW-846 protocols, the calibration procedures and frequencies specified in the applicable methods will be followed. For analyses governed by SOPs, refer to the appropriate SOP for the required calibration procedures and frequencies. All analytical calibrations and method QC will be consistent with the applicable method requirements and with Table 3-1.

Records of calibration will be kept as follows:

- Each instrument will have a record of calibration with an assigned record number.
- A label will be affixed to each instrument showing identification numbers, manufacturer, model numbers, date of last calibration, signature of calibrating analyst, and due date of next calibration. Reports and compensation or correction figures will be maintained with the instrument.
- A written stepwise calibration procedure will be available for each piece of test and measurement equipment.
- Any instrument that is not calibrated to the manufacturer's original specification will display a warning tag to alert the analyst that the device should not be used.

5.3 Laboratory QC Procedures

Analytical QC procedures for these investigations are specified in the individual method descriptions. Laboratory QC samples consist of method blanks, instrument blanks, laboratory control samples, calibration check standards, matrix spike, and laboratory duplicate analysis.

To ensure the production of analytical data of known and documented quality, laboratories associated with these investigations will implement all method QA and QC checks.

5.3.1 QA Program

All subcontracted analytical laboratories will have a written QA program that provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA program is coordinated and monitored by the laboratory's QA department, which is independent of the operating departments. For these investigations, selected support laboratory QA Plans will be referenced and implemented in their entirety.

The stated objectives of the laboratory QA program are to:

- Properly collect, preserve, and store all samples
- Maintain adequate custody records from sample collection through reporting and archiving of results
- Use properly trained analysts to analyze all samples by approved methods within holding times
- Produce defensible data with associated documentation to show that each system was calibrated and operating within precision and accuracy control limits
- Accurately calculate, check, report, and archive all data using the Laboratory Information Management System (LIMS)
- Document all of the above activities so that all data can be validated using USACE ADR software

All laboratory procedures are documented in writing in the SOPs, which are edited and controlled by the QA department. Internal QC measures for analysis will be conducted with their SOPs and the individual method requirements specified.

5.3.2 QC Checks

Implementation of QC procedures during sample collection, analysis, and reporting ensures that the data obtained are consistent with its intended use. Both field QC and laboratory QC checks are performed throughout the work effort to generate data confidence. Analytical QC measures are used to determine if the analytical process is in control, as well as to determine the sample matrix effects on the data being generated.

Specifications include the types of QC required (duplicate, sample spikes, reference samples, controls, blanks, etc.), the frequency for implementation of each QC measure, and the acceptance criteria for this QC.

Laboratories will provide documentation in each data package that both initial and ongoing instrument and analytical QC functions have been met. The laboratory will reanalyze any non-conforming analysis, if sufficient sample volume is available. It is expected that sufficient sample volumes will be collected to provide for reanalysis, if required.

5.3.2.1 Analytical Process QC

Samples will be extracted and analyzed in batches, not to exceed 20 samples, which are uniquely identified. Two types of batches are identified, the preparation batch and the analytical, or instrumental, batch. The preparation batch is defined as samples that are prepared together by the same person using the same equipment/glassware with the same method sequence and the same lots of reagents undergoing common manipulations for each sample within the same time period or in limited continuous sequential time periods. The analytical batch is defined as samples that are analyzed together within the same analytical run sequence, within the same time period, or in continuous time periods. Included in each batch will be a number of QC samples including a method blank, laboratory control sample (LCS), and matrix spike (MS) or matrix duplicate (MD).

Samples that require reanalysis due to target analyte concentrations exceeding calibration curve will be diluted and reanalyzed. The diluted sample aliquot will be either added to the current analytical batch sequence or included in a succeeding batch. In either case the sample will remain related to its original preparation batch QC (prep-blank, duplicate and etcetera) and successive analytical batch QC (method blank, post digestion spike and etcetera) as required. In the event that the sample requires re-preparation it will then be associated with the new set of preparation batch QC.

5.3.2.1.1 Method Blank

Method blanks are analyzed to assess the level of background interference or contamination that exists in the analytical system and that might lead to the reporting of elevated concentration levels or false positive data. The method blank is a QC sample that consists of a blank matrix (e.g., deionized laboratory water, purified solid matrix) to which all reagents specific to the method are added and which is carried through every aspect of the procedure, including digestion, distillation, extraction, and analysis. At least one method blank will be analyzed with every batch of samples processed. Results of the method blank analysis are evaluated, in conjunction with other QC information, to determine the acceptability of the data generated for that batch of samples. Potential sources of contamination include solvents, reagents, glassware, other sample processing hardware, or the laboratory environment. Sample results will not be corrected for blank contamination.

5.3.2.1.2 Laboratory Control Sample

The LCS contains known concentrations of analytes representative of the contaminants to be determined and is carried through the entire preparation and analysis process. The standard solution used to prepare the LCS is separate from that used in establishing the calibration curve. The LCS is used to monitor the laboratory's day-to-day performance as well as the ongoing performance of the analytical methods. Day-to-day performance is characterized by the measure of the accuracy of the results. Ongoing monitoring of the results provides evidence that the laboratory is performing the method within both acceptable accuracy and precision guidelines. The results of the LCS can provide evidence that the laboratory performed the method correctly or

that the sample matrix affected the results. An LCS must be analyzed with each analytical sample batch.

5.3.2.2 Matrix and Sample-Specific QC

5.3.2.2.1 Matrix Spike

A MS is an environmental sample to which known concentrations of target analytes have been added. MS samples are collected at a frequency of 5 percent of the environmental samples and analyzed to evaluate the effect of the sample matrix on the analytical methodology. MS samples are generated by taking a separate aliquot of an actual field sample and spiking it with the selected target analyte(s) prior to sample preparation or extraction. The MS sample then undergoes the same extraction and analytical procedures as the unfortified field sample. Due to the potential variability of the matrix of each sample, these results may have immediate bearing only on the specific sample spiked and not on all samples in the QC batch. The concentration(s) of the analyte(s) in the unfortified field sample may also affect the recovery of the spiked analyte(s), especially if the analyte concentration(s) are near or above the instrument calibration range.

5.3.2.2.2 Laboratory Duplicates

Laboratory duplicates are separate aliquots of a single sample that are prepared and analyzed concurrently at the laboratory. This duplicate sample should not be a method blank or field blank. The primary purpose of the laboratory duplicate is to check the precision of the laboratory analyst, the sample preparation methodology, and the analytical methodology. If there are significant differences between the duplicates, the affected analytical results will be reexamined. One in 20 samples will be laboratory duplicate, with fractions rounded to the next whole number.

5.3.2.2.3 Method-Specific QC

The laboratory must follow specific quality processes as defined by the method. These will include measures such as calibration verification samples, instrument blank analysis, method of standard additions utilization, serial dilution analysis, post-digestion spike analysis, etc.

5.4 System and Performance Audits

CDM is responsible for its own system audits. USACE will be provided with a copy of the audit reports. Two types of system audits may be conducted, the technical system audit and the internal system audit.

The technical system audit is used to verify that a system of quality control measures, procedures, reviews and approvals were established and used as specified in the QAPP (e.g., preserving, shipping, documenting, and analyzing the samples). Technical systems audits are conducted by a qualified auditor under the direction of the CDM QA director (QAD). Technical system audits may be conducted in the field or at a subcontract laboratory. The auditor coordinates with the CDM Project Manager to identify the field activities or analytical procedures that are in progress during the audit and obtains documents governing those activities. The auditor prepares a checklist specific to the activities to be performed and observes them to verify

compliance with the QAPP. USACE is informed that a technical system audit will be conducted before its implementation.

An internal system audit may be performed during this work assignment. This audit evaluates the use of QC measures and includes: interviewing the Project Manager and project personnel; determining whether work has been conducted according to governing documents; determining whether deliverables identified in the work plan have been prepared; determining whether documents received proper technical and/or QA review; reviewing files for appropriate memos, QC records, or other documentation; and examining the central files to verify filing of deliverables. The QAD or his designee is responsible for conducting internal system audits. Technical and internal system audits are conducted following the procedures outlined in the CDM QA Manual. USACE may also conduct or arrange for system audits.

Performance audits, which involve the submittal of a performance evaluation (PE) sample to a laboratory, will be the responsibility of USACE for the subcontractor laboratories. These PE sample audits will include those administered by USACE and applicable federal or state agencies or other entities.

5.5 Corrective Actions

Corrective actions may be required for two major types of problems: analytical/equipment problems and noncompliance with criteria. Analytical and equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, and data review.

Noncompliance with specified criteria and analytical/equipment problems will be documented through a formal corrective action program at the time the problem is identified. Laboratory deficiency and tracking notification will be implemented if any deviations or departures from the approved SAP or standard sampling and analysis methodologies which may affect the achievement of project DQOs or the usability of the data is identified throughout the performance of field-dependent (e.g., sample shipping, chain-of-custody) or laboratory activities. The person identifying the problem is responsible for notifying the Project Manager and the USACE Project Manager. When the problem is analytical in nature, information on these problems will be promptly communicated to the ASC. Implementation of corrective action will be confirmed in writing.

Any nonconformance with the established QC procedures in the FSP will be identified and corrected in accordance with the QAPP. Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels.

CDM personnel will confer with the laboratory as quickly after the notification as practical to discuss the ramifications of the deficiency with regard to project DQOs and potential effects on the reportability and validity of sample data. Deficiencies which may prevent meeting contractual DQOs or which preclude the use of data in final Site reporting may require reanalysis, reevaluation, or resampling. If corrective actions are

deemed insufficient, work may be stopped through a stop-work order issued by the CDM Project Manager and the USACE Project Manager.

5.5.1 Sample Collection/Field Measurements

If a nonconformance or deficiency is identified during the field work or during a technical or internal systems audit, corrective action will be initiated by the project team and its subcontractors as defined in Section 8 of Part 2 Quality Procedures of the CDM QA Manual. The corrective action steps are:

- Identify and define the problem
- Assign responsibility for investigating the problem
- Determine corrective action to eliminate the problem
- Assign responsibility for implementation of the corrective action
- Implement the corrective action
- Verify that the corrective action has eliminated the problem
- Document the problem identified, the corrective action taken, and its effectiveness in eliminating the problem

According to the CDM QA Manual, the auditor will be responsible for filing an audit report along with a Corrective Action Request form, if any nonconformances are noted during the system audit. The audit report will be formally approved by the QAD and distributed to the audited party, CDM program management, and USACE. The Project Manager must accept overall responsibility for completion of all appropriate corrective actions. The FTL will be responsible for initiating, undertaking, and completing any corrective actions associated with the field activities. Each team member is responsible for adherence to corrective action guidelines.

The project team also will be responsible for reporting all suspected technical nonconformances by initiating a corrective action as described in the CDM QA Manual. Any staff member who discovers or suspects a nonconformance, which is an identified or suspected deficiency from an approved document, also is responsible for initiating corrective action. The QAC is responsible for investigating the problem and following up on its resolution.

The Project Manager will ensure that no additional work, which is dependent on the nonconforming activity, is performed until the nonconformance is corrected. Following completion of corrective actions, the QAD or his designee will determine whether all nonconformances have been adequately addressed. If nonconformances have not been adequately addressed, the subsequent steps outlined in the CDM QA Manual will be taken until the nonconformance has been corrected. An audit completion notice will be completed at this time.

5.5.2 Laboratory Analysis

5.5.2.1 Identification and Documentation of Problem

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation procedures for possible errors, checks the instrument

calibration, spike, calibration solutions, instrument sensitivity, and so on. The laboratory section heads, department manager, and/or QA/QC Manager will be advised if the problem persists or cannot be identified. Once resolved, full documentation of the deficiency/corrective action procedure will be submitted to the ASC and filed with the project records. The deficiency and corrective action will also be summarized within the case narrative. If the problem encountered requires that a sample or group of samples be re-extracted and/or reanalyzed, the QA/QC Manager will initiate the corrective action by filling out a Sample Re-Extraction/Reanalysis Form.

Other corrective actions may be required that do not involve sample reanalysis. In these cases, the QA/QC Manager will notify the analyst or technician of a problem through a QC memorandum. If the problem is significant enough to impact the quality of the data, the QA/QC Manager may stop the analysis of additional samples until the problem is resolved. The analyst or technician must record onto the memo a description of the corrective action(s) taken and the date it was performed. The memorandum will be returned to the QA/QC Manager for review. If the corrective action has mitigated the problem, analysis of samples can be resumed. If not, the QA/QC Manager may issue another memo detailing the additional actions that need to be taken in order to resolve the problem.

If, upon repeated attempts, the QA/QC Manager feels that the actions taken have not satisfactorily corrected the problem, he/she will inform the appropriate corporate officer of the problem. The problem will then be resolved through a joint effort between the laboratory management, the QA/QC Manager, and the corporate officer. Any problems affecting the quality of the data from the analysis of samples from the Site will be detailed in the case narrative of the final analytical result report. If it appears that the problem will affect sample holding times or delay the timely reporting of analytical results, the QA/QC Manager will notify the Project Manager and/or Project Chemist.

5.5.2.2 Problems and Actions

5.5.2.2.1 Sample Receipt

Problems noted during sample receipt will be documented on the cooler receipt checklist as described in Section 4.1.1. If irregularities are noted, the Sample Custodian will submit the cooler receipt checklist to the laboratory QA/QC Manager or the laboratory Project Manager, who in turn, will contact the ASC. A decision concerning the disposition of the sample shipment in question will be made. USACE will also be contacted immediately for problem resolution (e.g., recollect samples, analyze samples "as is", etc.), if necessary. All corrective actions taken will be thoroughly documented on the cooler receipt checklist. This written record will contain, at a minimum, the time and date of the conversation, the name of the Site contact, the names of any off-Site individuals involved in the decision, and the resolution reached with respect to the irregularity. Some examples of irregularities encountered during sample receipt, which may require consultation to determine corrective action, include:

- Custody seal on cooler is broken or appears to have been tampered with
- Temperature inside cooler is outside the acceptable temperature range
- Broken sample container(s) or missing container(s)
- Unlabeled, mislabeled, or illegible sample container(s)
- Improperly preserved sample(s)
- Chain-of-custody form incomplete, improperly completed, or illegible

5.5.2.2.2 Sample Holding Times

If samples cannot or were not extracted/digested and/or analyzed within the appropriate method required holding times, the CDM Project Manager, and USACE Project Manager will be notified immediately for problem resolution. All corrective actions will be thoroughly documented on the case narrative to be included in the final laboratory analytical data report.

5.5.2.2.3 Instrument Calibration

Sample analysis will not be allowed until all initial calibrations meet the appropriate requirements. All calibrations must meet method calibration requirements or recalibration must be performed.

When the continuing calibration is outside the acceptable range, the problem should be identified by the analyst and corrected before any sample analysis is undertaken. If the non-acceptability of the continuing calibration is not determined by the analyst, the QA/QC Manager will notify the appropriate analyst that a new calibration curve must be prepared or the continuing calibration standard should be checked. All continuing calibrations that do not meet method requirements will result in a review of the calibration, rerun of the appropriate calibration standard(s), and, if necessary, reanalysis of all samples affected back to the previous acceptable calibration check.

5.5.2.2.4 Calibration Standards

Calibration standards will not be used beyond their permitted shelf life.

5.5.2.2.5 Method Detection Limit

Appropriate sample cleanup procedures will be employed to attempt to achieve Method detection limit. If difficulties arise in achieving these limits due to a particular sample matrix, the sub-contract laboratory will notify ASC of this problem. The USACE Project Manager will also be notified immediately of the problem. Any dilutions made will be documented in the case narrative along with the revised method detection limits for those analytes directly affected.

5.5.2.2.6 Method QC

All method QC, including blanks, matrix duplicates, matrix spikes, laboratory control samples, and other method-specified QC samples will meet the requirements as specified within the analytical method. Failure of method-required QC will result in the review of all affected data. If no errors can be noted, the affected sample(s) will be reanalyzed and/or re-extracted/redigested, then reanalyzed within method-required holding times to verify the presence or absence of matrix effects. In order to confirm

matrix effects, QC results must observe the same direction and magnitude bias. If matrix effect is confirmed, the corresponding data will be flagged. If matrix effect is not confirmed, then the entire batch of samples may have to be reanalyzed and/or re-extracted/redigested, then reanalyzed.

The following corrective action procedures will be required:

Blanks
Failure to obtain analysis blank values less than the required detection limits requires that all samples associated with that analysis blank be re-prepared and reanalyzed for the affected parameters. The affected samples should only be reanalyzed after the contamination source has been identified and corrected (i.e., analytical data associated with a contaminated blank will not be accepted).

Matrix Spike (Percent Recovery)
If percent recoveries (%R) are out of control limits and the sample results are less than four times of spike concentration:

1. Reanalyze the sample and spikes if sufficient quantity is available. Report both sets of analysis in the raw data.
2. If percent recovery is still out of control, perform a post-digestion spike.
3. Calculate and report the percent recoveries. Summarize any deficiencies in the case narrative.

Matrix Duplicate (Relative Percent Difference)
If relative percent difference is out of control limits, no action is necessary.

Laboratory Control Sample
If quality control check sample is out of control limits:

1. Reanalyze the prepared quality control check sample and if still "out of control," re-extraction and reanalysis of associated samples is required.
2. Field sample or laboratory QC sample results associated with "out of control" quality control check sample analyses will not be accepted.

Sample Analyte Concentration Exceeds Calibration Range
If the concentration of analyte exceeds the calibration range for a particular analysis, the sample or sample extract will be reanalyzed at an appropriate dilution so that the analyte concentration in the diluted analysis is within calibration range. The results of both the undiluted analysis and the dilution analysis will be reported for the sample. The detection limit(s) reported for the affected sample(s) will be increase according to the required dilution.

Calculation Errors
Reports will be reissued if calculation and/or reporting errors are noted with any data package. The case narrative will clearly state the reason(s) for reissuance of a report.

Section 6
Calculation of Data Quality Indicators

6.1 Field Measurements Data

Field data will be assessed by the FTL. The FTL will review the field results for compliance with the established QC criteria that are specified in the QAPP and FSP. Accuracy of the field measurements will be assessed using daily instrument calibration and calibration check. Precession will be assessed on the basis of reproducibility by multiple reading of a single sample.

Field data completeness will be calculated using the following equations:

Sample Collection

$$\text{Completeness} = \frac{\text{Number of Sample Points Sampled}}{\text{Number of Sample Points Planned}} \times 100\%$$

Field Measurements

$$\text{Completeness} = \frac{\text{Number of Valid Field Measurements Made}}{\text{Number of Field Measurements Planned}} \times 100\%$$

6.2 Laboratory Data

Laboratory results will be assessed for compliance with required precision, accuracy, completeness and sensitivity as follows.

6.2.1 Accuracy

The accuracy of the laboratory analytical measurements process will be determined by comparing the measured value for the LCS versus its documented true value. The percent recovery (%R) for LCS will be calculated using the following equation:

$$\%R = \frac{\text{Measured Value}}{\text{True Value}} \times 100$$

Investigative sample accuracy will be assessed for compliance with the established QC criteria that are described in Section 3.0 of this QAPP using the analytical results of matrix spike. Accuracy is most commonly presented as percent recovery or percent bias and include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity. The percent recovery (%R) of matrix spike sample will be calculated using the following equation:

$$\%R = \frac{|SSR - SR|}{SA} \times 100$$

Where:

SSR = Measured value of the spiked sample
SR = Measured value of the unspiked sample
SA = Amount of the spike added

6.2.2 Precision

Investigative sample matrix precision will be assessed by comparing the analytical results between sample and matrix duplicate (laboratory duplicate). The precision is usually expressed as RPD. This precision measurement will include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity. Every batch of samples analyzed will include matrix duplicates to evaluate precision in this manner. Precision determined by RPD will be calculated as follows:

$$RPD = \left(\frac{|X_1 - X_2|}{\frac{(X_1 + X_2)}{2}} \right) \times 100\,\%$$

Where:
X_1 = First sample concentration (Original value)
X_2 = Second sample concentration (Duplicate value)

6.2.3 Completeness

Data completeness of laboratory analysis will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using the following equation:

$$\%C = \left(\frac{V}{N} \right) \times 100$$

Where:

V = number of measurements judged valid
N = number of valid measurements needed to achieve a specified statistical level of confidence

6.2.4 Sensitivity

Achieving practical quantitation limits (PQLs) depends on sample preparation techniques, instrumental sensitivity, and matrix effects. Therefore, it is important to first determine actual method detection limits (MDLs) through the procedures outlined in 40 CFR136, Appendix C. MDLs should be established for each major matrix under investigation through multiple determinations, leading to a statistical evaluation of the MDL. The PQL is set at 10 to 12 times the standard deviation

resulting from the MDL procedure. This value must meet the sensitivity requirements of the project as defined in Section 3.0 of this QAPP.

It is important to monitor instrument sensitivity through calibration blanks and low concentration standards to ensure consistent instrument performance. It is also critical to monitor the analytical method sensitivity through analysis of method blanks, and calibration check samples, etc.

6.2.5 Representativeness/Comparability

Representativeness express the degree to which data accurately reflect the analyte or parameter of interest for the environmental media examined at the site. It is a qualitative term most concerned with the proper design of the sampling program. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences. These factors will be evaluated by reviewing project documentation and QC analyses.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. These activities will employ narrowly defined sampling methodologies, site audit/surveillances, use of standard sampling devices, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting limits to ensure comparability to other data sets. Through proper implementation and documentation of these standard practices, the project will establish confidence that data will be comparable to other project and programmatic information.

Section 7
Data Reduction, Reporting and Review

7.1 Data Reduction

7.1.1 Field Measurements and Sample Collection

Raw data from field measurements and sample collection activities will be appropriately recorded in field logbooks. Data to be used in project reports will be reduced and summarized. The methods of data reduction will be documented.

The Project Manager or the Task Manager is responsible for data review of all field-generated data. This includes verifying that all field descriptive data are recorded properly, that all field instrument calibration requirements have been met, that all field QC data have met frequency and criteria goals, and that field data are entered accurately in all logbooks and worksheets.

7.1.2 Laboratory Services

Data reduction, evaluation, and reporting for samples analyzed by the laboratory will be performed according to specifications outlined in the laboratory's QA plan. Laboratory reports will include documentation verifying analytical holding time compliance.

Laboratories will perform in-house analytical data reduction under the direction of the Laboratory QA Manager. The Laboratory QA Manager is responsible for assessing data quality and informing the CDM and USACE of any data which are considered "unacceptable" or require caution on the part of the data user in terms of its reliability. Data will be reduced, evaluated, and reported as described in the laboratory QA plan. Data reduction, review, and reporting by the laboratory will be conducted as follows:

- Raw data are produced by the analyst who has primary responsibility for the correctness and completeness of the data. All data will be generated and reduced following the QAPP defined methods and implementation laboratory SOP protocols.
- Level 1 technical review is completed relative to an established set of guidelines by a peer analyst. The review shall ensure the completeness and correctness of the data while assuring all method QC measures have been implemented and were within appropriate criteria.
- Level 2 technical review is completed by the section heads or data review specialist. This reviews the data for attainment of QC criteria as outlined in the established methods and in this QAPP. It will ensure all calibration and QC data are in compliance and check at least 10 percent of the data calculations. This review shall document that the data package is complete and ready for reporting and archival.
- Upon acceptance of the raw data by the section heads, the report is generated and sent to the laboratory Project Manager for Level 3 administrative data review. This

review will ensure consistency and compliance with all laboratory instructions, the laboratory QA plan, the project Laboratory Statement of Work (SOW) and this QAPP.

- The Laboratory Project Manager will complete a thorough review of all reports.
- Final reports will be generated and signed by the Laboratory Project Manager.

A case narrative to accompany the final report will be prepared by laboratory project management. This narrative will include relevant comments from the earlier reviews as determined by the Laboratory Project Manager.

7.2 Data Reporting

Laboratory will prepare and submit two hard copies and two pdf copies (CD\Rom) of the complete analytical data package.

7.2.1 Laboratory Analytical Data Report Package

Analytical results will be in a format consistent with and equivalent to the Contract Laboratory Program (CLP) like deliverables, including raw data as defined in New Jersey Technical Regulations N.J.A.C. 7:26E, Appendix A. Unless an alternative is required for a specific analysis and approved by USACE, analysis will be reported in this CLP format.

Upon request, documentation files pertaining to standards and standard preparation must be submitted with the data package. EPA QC reference standards, or any other reference standards or initial calibration verification standards, will be identified as to source and lot number.

A. For each sample delivery group (SDG), all sample analysis must be completed and the written report and computer-readable format submitted to the CDM ASC within the specified days (as stated in the applicable SOW) of the last sample receipt for that SDG.

B. The following documentation is required with SDG deliverables:

1) Data sheets with tabulated results. Data sheets must contain all information required for EPA CLP Form Is.

2) QA/QC information forms including but not limited to:

a) initial and continuing calibration verification, CLP Form IIAs
b) Contract Required Detection Limits (CRDL) standard for inductively coupled plasma (ICP), CLP Form IIAs
c) blanks, CLP Form IIIs
d) ICP interference check sample, CLP Form IVs
e) spike sample recovery, CLP Form Vas
f) post digestion spike sample recovery, CLP Form Vbs
g) duplicates, CLP Form VIs

h) laboratory control sample, CLP Form VIIs
i) standard addition results, CLP Form VIIIs (when implemented)
j) ICP serial dilutions, CLP Form IXs
k) instrument detection limits (quarterly), CLP Form Xs
l) ICP interelemental correction factors (annually), CLP Forms XIA and XIB
m) ICP linear ranges (quaterly), CLP Form XIIs
n) preparation log, CLP Form XIIIs
o) analysis run log, CLP Form XIVs

3) Written case narrative describing all factors affecting the analysis and all corrective actions taken, including but not limited to:

a) problems with the receipt, preparation and/or analysis of samples and/or QC results
b) the actual method used for preparation and analysis
c) justification for any dilution and reanalysis of any samples or extracts and/or digestates. CDM management must approve these dilutions and reanalysis before they will be accepted as a separate cost unit
d) summary table of laboratory ID versus CDM's sample ID numbers
e) modification made to the methods (the laboratory must immediately inform CDM's of such modifications)
f) any analytical problems or inconsistencies in data and corrective action taken to resolve the problem

4) Raw data to include but not be limited to:

a) CDM's sample ID number that must appear on all raw data
b) run logs, instrument printouts and any other information necessary to validate during independent data review the results reported on data sheets
c) Sample packing lists, COC records and log-in record sheets
f) The laboratory will also be required to provide their current laboratory QA Management Plan, SOPs, personnel resumes, audit reports, state or national certification program documentation, and PE sample results within 24 hours of request by CDM

The data packages must be submitted unbound, paginated, and sequentially numbered.

The laboratory is required by the applicable SOW to archive data reports and associated raw data after submittal of the final SDG.

Statement 4 (f) above refers to ad hoc requests for the current laboratory QA Management Plan and other documentation as an on-going stipulation of the contract after contract award. These documents will be initially requested and evaluated by technical and QA reviewers prior to award as part of the procurement process.

Data will be conveyed in draft and final reports to the USACE Project Manager. Such reports will receive technical and QA review prior to submittal. These measurement reports will contain a QA section discussing how well the data met project DQOs, and any qualifications or problems identified when evaluating the data results.

Storage control of validated data will be performed by CDM.

All project documentation will be maintained in the project files by the Project Manager until the project undergoes final closeout procedures. Copies of all deliverables submitted to USACE will also be maintained in the project files.

See Section 7.3 for further details regarding data management.

7.2.2 Electronic Data Deliverables (EDD)

In addition to hardcopy and CD\Rom (pdf) data packages, the laboratory will provide the electronic deliverables to CDM. The electronic data deliverables should be reported as described below and detailed in Appendix A.

EDD Format

EDD format shall be compliant with USACE ADR specification. The detailed specification is described in Appendix A. An ADR EDD will be delivered for each laboratory report (i.e., Sample Deliver Group). ADR designated Tables A1, and A3 will be generated directly from the LIMS.

ADR EDD Check Program for the Library

At the beginning of the project, CDM will provide the laboratory the ADR EDD software application. This application resides on a Microsoft ACCESS platform. CDM and the laboratory will define the ADR project library containing laboratory and sample QC criteria. This library will be forwarded to USACE for their approval prior to sample collection. The laboratory shall be responsible to perform the electronic verification against the project specific library prior to delivery of the EDD and pass all data integrity checks. The EDD shall meet all requirements and specifications of Appendix A. The final checked EDD will be sent with the associated Error Log from the ADR program to CDM upon completion. The EDD must not have correctable errors upon final submission. If EDDs are submitted with uncorrectable errors (i.e., no MS results due to insufficient sample volume, etc.) this notation must be made in the Error Log submittal. The Error Log will be considered the "Case Narrative" for the EDD submittal.

The ADR library contains a compilation of laboratory and project specific QC criteria as outlined in Tables 3-1 & 3-4 and in section 7.4 of this QAPP. The QC criteria outlined in this QAPP will be justified against the laboratories internal control criteria prior to sampling. If necessary an addendum to the QAPP will be forwarded with the ADR library to document the final project DQOs.

EDMS Data Deliverable

After the laboratory EDD are processed through the ADR software. The ASC will produce a final EDD with appended data qualifiers from the ADR software for transferred to USACE. Prior to transfer, the ACS will verify these deliverables by uploading and storing them into the EDMS data base included with the ADR software. The USACE deliverable will consist of the ADR EDD, ADR output files, EDMS database with criteria library and EDMS tables 1-4.

Upon USACE acceptance of the EDMS database and ADR deliverables CDM will archive the entire project to either a CD or DVD. The selected media will be dependent on project size. The EDMS database will also be archived on CDM's networked tape backup system.

7.3 Data Management Procedures

The ASC is responsible for tracking samples from the point of field collection to submittal for laboratory analysis and the subsequent data validation and data management efforts. The ASC will receive analytical data from the laboratories and track it through the data validation process. The ASC will initiate Data Package Chain-of-Custody Form. All transfers of the data package from one individual to the next must be recorded on the custody record. The data package itself must remain under lock and key when not undergoing processing. The ADR performed by CDM will be in accordance with the procedures described in Section 7.4.

A project-specific electronic spreadsheet will be developed for sample tracking purposes prior to field activities. The tracking system will be initiated in the field during sample collection and will be updated during the sample analysis and ADR phases. The data will be entered by project staff and then checked by the ASC or designee for accuracy. This tracking system will ensure that no data is lost during the data management process.

The following information is recorded in the tracking system:

- Sample Number
- Sample Matrix
- Sample Delivery Group Number
- Laboratory Project Number
- Sample Location Identification No.
- Analytical Parameter
- Collection Date
- Shipment Date
- Date Received from Lab
- Date Submitted for ADR
- Name of Data Validator
- Date of Data Validation Completion

- Comments (i.e., MS designation, duplicate samples).

After the data has been reviewed, the package is returned to the ASC. The original data package with all associated forms will be boxed and coded for subsequent archival by the USACE.

7.4 Automated Data Review

A systematic process for data assessment will be performed to ensure that the precision and accuracy of the analytical data are adequate for their intended use. The greatest uncertainty in a measurement is often the result of the sampling process and inherent variability in the environmental media rather than the analytical measurement. Therefore, analytical data review will be performed to minimize the potential of using false positive or false negative results in the decision-making process (i.e., to ensure accurate identification of detected versus non-detected compounds). This approach is consistent with the data quality objectives for this project, with the analytical methods, and for determining contaminants of concern and calculating risk.

Data review will be accomplished by comparing the contents of the laboratory data package and QA/QC results to requirements contained in the analytical methods and in this QAPP. The data review will be performed using the USACE ADR software application which automatically reviews the reported sample and QA/QC results in comparison to the requirements provided in the project library. The following steps will be performed during the automated data review process:

- Import EDD into data review software
- Print/review EDD error log/report
- Rerun EDD error check against project library to confirm laboratory EDD error check
- Assign field QC in the EDD, if applicable
- Run automated data review
- Review post data-review results on screen and/or reports. Make any necessary changes to data review qualifiers

Using ADR (via the project library), the CDM Project Chemist will conduct a systematic review of the analytical data and QA/QC sample results for compliance with the established guidance based on the following criteria:

- Chain-of-custody
- Preservation
- Requested analyses
- Holding time
- Blanks
- Calibration verification
- LCS percent recoveries

- Blind field QC duplicates
- MS recoveries
- Laboratory duplicate RPDs
- Sample detection limits

All project data will be evaluated on these categories and qualified as per the outcome of the review. The Project Chemist may use professional judgment during the review process whereby data qualifiers may be assigned differently from those required following a literal interpretation of the Guidance. Such circumstances will be clearly and completely documented in the validation report. Information gathered during this evaluation process will be summarized using the ADR error log and appropriate outlier log reports (if any).

This data review will indicate that data are: (1) usable as a quantitative concentration, (2) usable with caution as an estimated concentration, or (3) unusable due to out-of-control QC results.

Each data assessment category and associated qualification requirements are summarized below:

- **Chain-of-Custody** - Determine if the chain-of-custody form is present, properly completed, and properly signed. In addition, inspect the cooler receipt checklists to determine if the laboratory noted any problems upon receipt of the sample cooler. Sample results may be rejected if the identity of any samples is in doubt.

- **Preservation** - Determine if sample integrity has been maintained from the time of sample collection through analysis. Samples that were improperly preserved may be rejected. Likewise, any samples requiring cooling as part of their preservation will be qualified as estimated (i.e., "J" code) if the laboratory received them in the temperature range of 6-9°C.

- **Requested Analyses** - Determine if the chain-of-custody-requested analyses were performed by the requested methods.

- **Holding Times** - Evaluation of holding times ascertains the validity of results based on the length of time from sample collection to sample preparation or sample analysis. The evaluation of holding time is essential for establishing sample integrity and representativeness. Concerns regarding chemical, physical, or biochemical alteration of analyte concentrations can be eliminated through this evaluation. If a holding time is missed, associated sample results may be rejected.

- **Blanks** - The assessment of blank data is performed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks applies to any blank associated with the samples, including calibration blanks, rinsate blanks, and method blanks. Field sample results will be qualified as

undetected ("U" code) if the concentration in the sample is less than five times in any associated blank, reported with the same detection limit.

- **Calibration Verification** – The purpose of initial and continuing calibration verification analyses is to verify the linear range and stability of instrument response. Relative instrument response is used to quantify the analyte results. If relative response factor is outside acceptable limits, the data quantification is uncertain and requires appropriate qualification. Sample results will be qualified as estimated (J) if the %R is between 75-89% or 111-125%, and will be rejected (R) if the % R is outside the range of 75-125%.

- **Laboratory Control Samples.** The LCS serves as a monitor of the overall performance of the analytical process, including sample preparation, for a given set of samples. Evaluation of this standard provides confidence in or allows qualification of results based on a measurement of process control during each sample analysis. If the LCS recoveries are outside of the accuracy and precision limits set by the laboratory (80-120%), the associated data will be qualified as estimated (J) if the %R is within 60-140% and will be rejected (R) if the %R is outside the 60-140%.

- **Blind Quality Control Duplicate Samples** - The degree of agreement between field duplicate samples is to be used in conjunction with other QC results as an aid in determining the overall quality of the data. Data will be considered in agreement if the results are within a factor of two of each other. Data between a factor of two and three of each other will be considered a minor discrepancy and data greater than a factor of three should be considered a major discrepancy. Data will be not qualified due to blind QC duplicates alone.

- **Matrix Spike** - If the recovery values are outside the QC limits (75-125%) and corrective actions solved the problem, all data generated will be acceptable without qualification. If the corrective action did not solve the problem, the sample results should be "J" qualified. If corrective actions were not performed, sample results should be rejected for associated sample results.

- **Matrix Duplicate** – If the relative percent difference between the sample and duplicate results are outside the ±50%, qualify the associated sample results as estimated (J).

- **Sample Detection Limits** - The laboratory must supply a reason for any detection limits reported outside of the required limits. No further action is necessary if the cause is uncorrectable. Resample and reanalysis may be required if the cause can be corrected.

Section 8
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USACE. 2004. Statement of Work (SOW) to perform field investigation Activities at Vineland Chemical Superfund Site, Task Order No. CF02, Revised November 1.

USACE. Automated Data Review User Manual, Version 6.1, Prepared by Laboratory Data Consultants, Inc. for USACE- Philadelphia and Baltimore District.

Table 3-1
Analytical Sampling Program Summary
OU3 Blackwater Branch Investigation
Vineland Chemical Superfund Site
Vineland, New Jersey

Base Work

Analytical Parameter	Sample Matrix	Number of Samples [1]	Analytical Method	Sample Preservation (b)	Holding Time	Containers
TCLP Arsenic	Soil	5	SW-846 1311/ 6010B (a)	Cool to 4 °C	180 days	One 4-oz. amber glass jar
Total Arsenic	Soil	265	SW 846 3050B/6010B (a)	Cool to 4°C	180 days	One 500 mL CWM
Grain Size	Soil	27	ASTM D422-63	Cool to 4 °C	NA	One 500 mL CWM
Total Arsenic	Field Blank	10	SW 846 3020A/6010B (a)	HNO_3 to pH < 2, Cool to 4°C	180 days	One 1-L polyethylene bottle

Option 1

Analytical Parameter	Sample Matrix	Number of Samples [1]	Analytical Method	Sample Preservation (b)	Holding Time	Containers
Total Arsenic	Soil	100	SW 846 3050B/6010B (a)	Cool to 4°C	180 days	One 4-oz. glass jar
Total Arsenic	Field Blank	5	SW 846 3020A/6010B (a)	HNO_3 to pH < 2, Cool to 4°C	180 days	One 1-L polyethylene bottle

Notes:
1. This number does not include duplicate samples; the number only reflects environmental sample locations. The number of duplicate samples are indicated on Table 4-3. See Table 4-3 for the sample summary which includes a breakdown of the number of samples required for the various field operations.
(a) Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, 3rd Edition (SW-846).
(b) Add preservatives to sample container prior to adding sample.

ABBREVIATIONS USED:

L	Liter	ml	Milliliter	C	Celsius
NA	Not applicable	oz	Ounce	HNO_3	Nitric Acid
TCLP	Toxicity Characteristics Leachate Procedure				

Table 3-2
Quality Assurance/Quality Control Samples
OU3 Blackwater Branch Investigation
Vineland Chemical Superfund Site
Vineland, New Jersey

Analytical Parameter	Sample Matrix	Investigative Samples	Matrix Spike/Duplicate Designation (a)	Field Duplicate	Trip Blank (b)	Rinsate Blank (b)	Total (c)
Soil							
TAL Inorganics	Soil	265	14[a']	14	NA	10	279
Grain Size	Soil	27	NA	0	NA	10	27
TCLP Arsenic	Soil	5	0	0	NA	NA	5
TOTAL		297	17	14		20	311

Notes:

a. Matrix spike samples will consist of designated sample bottles drawn from excess volumes of existing sample. Therefore, they do not count as additional samples. Matrix spikes will be designated at a rate of one per sample per delivery group. No extra volume is required for soil samples. Samples denoted [a'] will not require additional volume but are designated for laboratory duplicate analysis only.

b. Based on the anticipated number of sampling days. One rinsate blank will be collected for each equipment type per decontamination event and will be analyzed for the same constituents as the environmental samples. Rinsate blanks, also known as "field blanks" or "equipment blanks" are used to assess the effectiveness of equipment decontamination. Rinsate blanks will be collected before the use of the decontaminated equipment for sampling. The frequency for rinsate blanks is one per decontamination event, not to exceed one per day, for each equipment type and for each sample matrix.

c. Total does not include matrix spike or field or trip blanks.

NA Not applicable.

Table 3-3
Analytical Detection Limits
OU3 Blackwater Branch Investigation
Vineland Chemical Superfund Site
Vineland, New Jersey

Parameter (1)	Matrix	EPA Method/ SOW	Sensitivity	Detection limit based on Project Specific Soil Cleanup Objectives
Soil:				
TCLP Arsenic	Soil	SW-846 1311/ 6010B	5 mg/L	5 mg/L
Total Arsenic	Soil	SW 846 3050B/ 6010B	3 mg/kg	20 mg/kg
Grain Size	Soil	ASTM D422-63	NA	NA

Notes:

(1) Analytical detection limits apply to all samples collected in the base and option periods.

NA No criteria is specified for this parameter. Use the detection limit of cited EPA method in order to meet the expected concentration range.

TABLE 3-4
DQI SUMMARY
VINELAND CHEMICAL COMPANY SUPERFUND SITE
VINELAND, NEW JERSEY

Parameter	Matrix	Analytical Method (a)	Precision (RPD) (b)		Accuracy %Recovery		Sensitivity (c)	Completeness %
			Field Dup.	Lab Dup.	LCS	MS		
Total Arsenic	Soil/Sediment	SW-846 3050B/6010B	50 (d)	20 (d)	80-120	75-125	1 mg/kg	90
Total Arsenic	Aqueous	SW 846 3050B/6010B	50 (d)	20 (d)	80-120	75-125	10 ug/L	90
TCLP Arsenic	Soil/Sediment	SW 846 1311/6010B	50 (d)	20(d)	80-120	75-125	50 ug/L	90
Grain Size	Soil/Sediment	ASTM D 422-63	NA	20	NA	NA	NA	90

DQO Data Quality Indicators
RPD Relative Percent Difference
LCS Laboratory Control Sample
MS Matrix Spike
TCLP Toxicity Characteristic Leaching Procedure
ASTM American Society of Testing and Materials
NA Not Applicable
mg/kg milligram per kilogram
ug/L microgram per liter

Notes

a. Test Methods for Evaluation Solid Waste Physical/Chemical Methods, USEPA, SW-846, Third Edition Final Updates, I, IIA, IIB, revised May 1997 and Standard Method for Particle-Size Analysis of Soils, ASTM D 422-63, reapproved 2002.
b. Measured as the relative percent difference of laboratory duplicate or field duplicate samples.
c. Required detection limit.
d. Where sample and duplicate value is less than 5 times contract required detection limit (CRDL), the precision requirements is ±CRDL.

TABLE 5-1
FIELD MEASUREMENT EQUIPMENT
VINELAND CHEMICAL COMPANY SUPERFUND SITE
VINELAND, NEW JERSEY

Instrument (parameter)	Reference	Calibrated Instrument Range
MultiRAE Dual PID-Toxic Gas Monitor	Manufacturer's Specifications	VOCs- 0-2000 ppm Oxygen – 0-30% LEL – 0-100% CO – 0-500ppm H2S – 0-100ppm

Notes:

CO	Carbon Monoxide
H2S	Hydrogen Sulfide
LEL	Lower Explosive Limit
PID	Photoionization Detector
ppm	Parts per million

TABLE 5-2
EQUIPMENT CALIBRATION
VINELAND CHEMICAL COMPANY SUPERFUND SITE
VINELAND, NEW JERSEY

Equipment Type	Calibration Frequency		Calibration Standard	Initial Calibration Tolerance		Post-run Calibration Tolerance		Calibrated Instrument Range	Field Check Frequency	Field Check Acceptance Range	Maintenance Frequency	
	Primary	Field		Primary	Field	Primary	Field				Primary	Field
Multi RAE Dual PID-Toxic Gas Monitor	S	When the unit fails to meet the field check acceptance range	—Primary— NIST traceable I-C_4H_2 in air. —Field— Commercially available I-C_4H_2 in air.	± 0.5ppm of STD.	± 0.5ppm of STD.	N/A	± 25% of the calibrated value.	0.1 - 2000 ppm	Beginning and end of each day	± 30% of the calibrated value	S	As needed

Primary refers to trained personnel, usually associated with the vendor, to perform required maintenance and calibration.

S Semi-Annually
ppm Parts per million
STD Standard
N/A Not Applicable
NIST National Institute of Standards and Technology
PID Photoionizaiton Detector

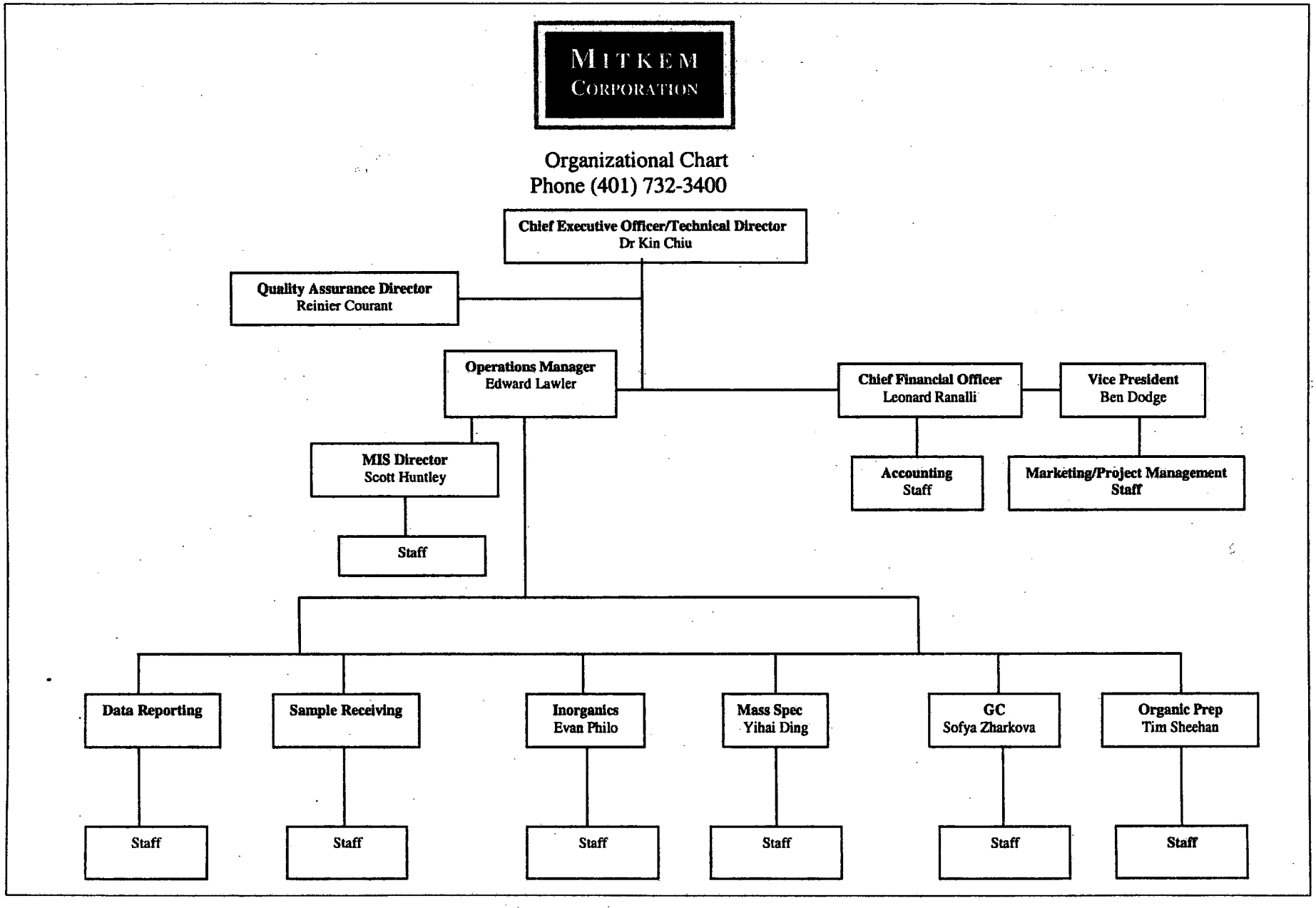
MITKEM CORPORATION
Organizational Chart
Phone (401) 732-3400
Chief Executive Officer/Technical Director
Dr Kin Chiu
Quality Assurance Director
Reinier Courant
Operations Manager
Edward Lawler
Chief Financial Officer
Leonard Ranalli
Vice President
Ben Dodge
MIS Director
Scott Huntley
Staff
Accounting
Staff
Marketing/Project Management
Staff
Data Reporting
Sample Receiving
Inorganics
Evan Philo
Mass Spec
Yihai Ding
GC
Sofya Zharkova
Organic Prep
Tim Sheehan
Staff
Staff
Staff
Staff
Staff
Staff

FIGURE 5-1
EQUIPMENT CALIBRATION LOG

Instrument (Name/Model No./Serial No.):_____

Manufacturer:_____

Calibration Date	Initial Setting	Standard/ Gas Used (Concentration)	Lot Control No. Expiration Date	Adjustments Made	Final Reading	Comments Pass/Fail	Signature

CDM

Quality Assurance Project Plan
APPENDIX A

Laboratory Electronic Deliverable Format

Electronic Data Deliverable File Specifications

The EDD consists of three separate, comma-delimited ASCII text files or Excel CSV files (two, if instrument calibration information is not required by the project). Each file corresponds to a database table. The tables are identified as the Analytical Results Table (A1), Laboratory Instrument Table (A2), and Sample Analysis Table (A3). Each file follows the naming convention of using the Laboratory Reporting Batch ID (SDG) followed by the table identifier (A1, A2, or A3), and then a ".txt" or ".csv" extension. For example, the EDD file names for a laboratory-reporting batch identified as SDG001 that includes instrument calibration data would be as follows.

SDG001A1.txt or SDG001A1.csv
SDG001A2.txt or SDG001A2.csv (A2 file is optional)
SDG001A3.txt or SDG001A3.csv

Analytical Results Table (A1 File)

The Analytical Results table contains analytical results and related information on an analyte level for field samples and associated laboratory quality control samples (excluding calibrations and tunes). Field samples and laboratory method blanks must report a result record for each analyte reported within a method. The method target analyte list is matrix dependent and specified in the project library. Laboratory control samples (LCS and LCSD) and matrix spike samples (MS and MSD) must report a result record for every analyte specified as a spiked analyte in the project library. The project library is a reference table the application uses for both EDD error checking and automated data review. The project library is populated with information from the project QAPP. Refer to the User Manual for detailed information on project libraries. Table A1 in this document lists the field names and descriptions for the Analytical Results Table (A1).

Laboratory Instrument Table (A2 File)

The Laboratory Instrument table contains results and related information on an analyte level for instrument initial calibration standards, initial calibration verification standards, continuing calibration standards, and GC/MS tunes. A record must exist for each target analyte reported in a method (specified in the project library), for every calibration type (field QCType) associated to samples reported in the EDD. Initial calibrations, initial calibration verifications, and associated samples are linked to each other using a unique Run Batch ID for every distinct initial calibration within a method. Continuing calibrations and associated samples are linked to each other using a unique Analysis Batch ID for every distinct continuing calibration within a method. GC/MS tunes are linked to initial and continuing calibrations (and hence samples) using the Run Batch and Analysis Batch IDs respectively. The Laboratory Instrument Table (A2) is optional. Depending on the level of validation required by the data user, the Laboratory Instrument table may not be requested in the deliverable. Table A2 in this document lists field names and descriptions for the Laboratory Instrument Table (A2).

Sample Analysis Table (A3 File)

The Sample Analysis table contains information on a sample level for field samples and laboratory quality control analyses (excluding calibrations and tunes). A sample record exists for each sample/method/matrix/analysis type combination. Table A3 in this document lists field names and descriptions for the Sample Analysis Table (A3).

EDD Field Properties

Tables A1, A2, and A3 in this document specify the EDD field properties[GO1]. These include the field name and sequence, field name description, data type and length for each field, and whether or not a particular field requires a standard field. Field elements in the EDD must be sequenced according to the order they appear in Tables A1, A2, and A3. For example, in the Analytical Result table (the A1 file), the field "ClientSampleID" will always be the first piece of information to start a new line of data (or database record), followed by the fields "LabAnalysisRefMethodID", "AnalysisType", and so on.

Standard values are listed in Table B for fields requiring standard values. Required field constraints depend on the combination of sample, matrix, method, analyte type, and calibration or QC type information reported in a record. Tables C1, C2, and C3 in this document indicate the required fields for each table according to the method category, matrix, analyte type, sample, and QC or calibration type reported in a record.

When creating an EDD as a text file, use the ASCII character set in a file of lines terminated by a carriage return and line feed. No characters are allowed after the carriage return and line feed. Enclose each data set in double quotes (") and separate each field by a comma (comma delimited). Data fields with no information (null) may be represented by two consecutive commas. For example, in the Sample Analysis table, since the "Collected", "ShippingBatchID", and "Temperature" fields do not apply to laboratory generated QA/QC samples, the record for a Laboratory Control Sample by Method 8270C would be entered as follows. Note that the first two fields ("ProjectNumber" and "ProjectName") are omitted in this example.

...“LCSW100598”,,”AQ”,”LCSW100598”,”LCS”,,”8270C”,... (and so on)

Do not pad fields with leading or trailing spaces if a field is populated with less than the maximum allowed number of characters. In the above example, although the "MatrixID" field can accommodate up to 10 characters, only 2 characters were entered in this field.

The EDD can be constructed within Excel and saved as .csv file for import into the application. Be sure to format all cells as text beforehand, otherwise Excel will reformat entered values in some cases.

Table A1
Field Descriptions for the Analytical Results Table (Table A1)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ClientSampleID	Client or contractor's identifier for a field sample If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the AnalysisType field is used for this distinction). For example, MW01DL and MW01RE are not allowed Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Analytical Results table for both EDDs.	Text	25	NO
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or a Lab Identifier for a method such as a SOP Number, however; method ID is specified by the project. The method ID must be entered into the standard list.	Text	25	YES (specified in project plan)
AnalysisType	Defines the analysis type (i.e., Dilution, Reanalysis, etc.). This field provides distinction for sample result records when multiple analyses are submitted for the same sample, method, and matrix; for example dilutions, re-analyses, and re-extracts.	Text	10	YES (See Table B)
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. There are no restrictions for the LabSampleID except for field length and that the LabSampleID must be distinct for a given field sample or lab QC sample and method. Suffixes may be applied to the LabSampleID to designate dilutions, reanalysis, etc.	Text	25	NO
LabID	Identification of the laboratory performing the analyses.	Text	7	NO
ClientAnalyteID	CAS Number or unique client identifier for an analyte or isotope. If a CAS Number is not available, use a unique identifier provided by the client or contractor. The ClientAnalyteID for a particular target analyte or isotope should be specified by the project and must exist in the standard value tables for Analytes. For the LCS, LCSD, MS, and MSD, it is only necessary to report the compounds designated as spikes in the library (and surrogates for organic methods.) For TICs from GC/MS analyses, enter the retention time in decimal minutes as the Client Analyte ID.	Text	12	YES (specified by project)

Table A1
Field Descriptions for the Analytical Results Table (Table A1)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
AnalyteName	Chemical name for the analyte or isotope. The project specifies how an analyte or isotope is named. The analyte name must be associated to a ClientAnalyteID in the standard values table for Analytes (excluding compounds designated as TIC's).	Numeric	60	YES (specified by project)
Result	Result value for the analyte or isotope. Entries must be numeric. For non-detects of target analytes or isotopes and spikes, do not enter "ND" or leave this field blank. If an analyte or spike was not detected, enter the reporting limit value corrected for dilution and percent moisture as applicable. Do not enter "0"	Text	10	NO
ResultUnits	The units defining how the values in the Result, DetectionLimit, and ReportingLimit fields are expressed. For radiochemistry this also includes how the value in the Error field is expressed.	Text	10	YES (specified by project in the library)
LabQualifiers	A string of single letter result qualifiers assigned by the lab based on client-defined rules and values. The "U" Lab Qualifier must be entered for all non-detects. Other pertinent lab qualifiers may be entered with the "U" qualifier. Order is insignificant. Lab qualifiers other than those listed in the standard values table may be used. If so, these must be added to the standard value table in the application.	Text	7	YES (See Table B)
DetectionLimit	For radiochemistry methods, the minimum detectable activity for the isotope being measured. For all other methods: The minimum detection limit value for the analyte being measured.	Numeric	10	NO
DetectionLimitType	Specifies the type of detection limit (i.e., MDA, MDL, IDL, etc.).	Text	10	YES (See Table B)
RetentionTime or Error	For radiochemistry methods only, enter the 2 Sigma Counting Error. The units for error are entered in the ResultUnits field. For GC/MS methods only, enter the time expressed in decimal minutes between injection and detection for GC/MS TICs only For target analytes in all other methods, leave this field blank. Note: GC retention times are not evaluated at this time.	Text	5	NO
AnalyteType	Defines the type of result, such as tracer, surrogate, spike, or target compound.	Text	7	YES (See Table B)
PercentRecovery	For radiochemistry methods: The tracer yield, if applicable. For all other analytical methods: The percent recovery value of a spiked compound or surrogate. If the spike or surrogate was not recovered because of dilution, enter "DIL". If a spike or surrogate was not recovered because of matrix interference, enter "INT". If a spike or surrogate was not recovered because it was not added to the sample, enter "NS".	Numeric	5	NO

Table A1
Field Descriptions for the Analytical Results Table (Table A1)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
RelativePercentDifference	The relative percent difference (RPD) of two QC results, such as MS/MSD, LCS/LCSD, and Laboratory Duplicates. Report RPD in Laboratory Duplicate, LCSD, and MSD records only.	Numeric	5	NO
ReportingLimit	Reporting limit value for the measured analyte or isotope Factor in the dilution factor and percent moisture correction, if applicable. The Reporting Limit for each analyte and matrix in a given method is specified in the project library or QAPP.	Numeric	10	NO
ReportingLimitType	Specifies the type of reporting limit (i.e., CRQL, PQL, SQL, RDL, etc). The Reporting Limit Type for each method and matrix is specified in the project library or QAPP.	Text	10	YES (specified by the project)
ReportableResult	This field indicates whether or not the laboratory chooses an individual analyte or isotope result as reportable. Enter "YES" if the result is reportable. Enter "NO" if the result is not reportable. This field applies to target analytes only. If only one analysis is submitted for a particular sample and method, enter "YES" for all target compounds (where Analyte Type = TRG). For GC/MS methods enter yes for tentatively identified compounds (where Analyte Type = TIC). If two or more analyses are submitted for a particular sample and method (i.e. initial analysis, reanalysis and/or dilutions), enter "YES" from only one of the analyses for each target compound. For example: a sample was run a second time at dilution because benzene exceeded the calibration range in the initial, undiluted analysis. All target analytes are reported in each analysis. For the initial analysis, (Analysis Type = RES), enter "NO" for benzene and enter "YES" for all other compounds. For the diluted analysis (Analysis Type = DL), enter "YES" for benzene and enter "NO" for all other compounds. For TICs (Analyte Type = TIC), if more than one analysis is submitted for a particular sample and method, choose only one of the analyses where Reportable Result = YES for all TICs. For example, a sample was run a second time because one or more target compounds exceeded the calibration range in the undiluted analysis. Choose a particular analysis and enter "YES" for all TICS. In the other analysis enter "NO" for all TICs. Note that it is not necessary to report the full target analyte list for the initial result, dilution, re-analysis, or re-extraction. However, each target analyte must be reported YES once and once only in the case of multiple analyses for a given sample, method, and matrix. In the case of organics, all surrogates must be reported for all analyses submitted for a given sample, method, and, matrix.	Text	3	YES (See Table B)

Table A2

Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
InstrumentID	Laboratory instrument identification.	Text	15	NO
QCType	Type of instrument QC (i.e., Instrument_Performance_Check or type of calibration standard).	Text	10	YES (See Table B)
Analyzed	Analysis date/time for BFB, DFTPP, initial calibration verification standards, calibration verification standards, and continuing calibration standards. For the initial calibration, enter date and time of the last standard analyzed. Also, see comments about initial calibrations in the Alternate_Lab_Analysis_ID field name description.	Date/ Time	*	NO
AlternateLab_AnalysisID	Common laboratory identification used for standards (i.e., VOA STD50, CCAL100, BFB50, etc). For initial calibration, enter ICAL. Information from the initial calibration is entered as one record for each analyte that summarizes the results of the initial calibration (i.e. %RSD, correlation coefficient, and avg RF). Records are not entered for each individual standard within the initial calibration.	Text	12	NO
LabAnalysisID	Unique identification of the raw data electronic file associated with the calibration standard or tune (i.e., 9812101MS.DV). Leave this field blank for the initial calibration. See comments about initial calibrations in the Alternate_Lab_Analysis_ID field description. This field is only applicable where an electronic instrument file is created as part of the analysis.	Text	15	NO
LabAnalysisRefMethodID	Laboratory reference method ID (i.e., 8260B, 8270C, 6010B, etc.). The method ID is specified by the project. The LabAnalysisRefMethodID must be in the standard value list for Method IDs.	Text	25	YES (specified by the project)
ClientAnalyteID	CAS number or unique client identifier for an analyte. If a CAS number is not available, use a unique identifier provided by the client. The unique identifier for a particular analyte should be specified by the project and must exist in the standard value list for ClientAnalyteID. Records for each calibration must report the full target analyte list including surrogates as applicable. The target analyte list is specified for each method and matrix in the project	Text	12	YES (specified by the project)
AnalyteName	The chemical name for the analyte. The project specifies how an analyte is named. The AnalyteName must be associated to a ClientAnalyteID in the standard values.	Text	60	YES (specified by the project)

Table A2
Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
RunBatch	Unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The Run Batch ID links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the Run_Batch ID also links a BFB or DFTPP tune and the initial calibration and initial calibration verification standards to associated samples and method QC analyses. A new and unique Run Batch ID must be used with every new initial calibration.	Text	12	NO
AnalysisBatch	Unique laboratory identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The Analysis Batch ID links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the Analysis Batch ID also links the BFB or DFTPP tune. A new and unique Analysis Batch ID must be used with every new continuing calibration or continuing calibration verification. For GC methods, only report opening standards, do not include closing standards (unless the closing standard functions as the opening standard for a subsequent set of analyses, in which case a new and unique Analysis Batch ID is assigned). When dual or confirmation columns/detectors are used, enter results from the primary column/detector only (this is similar to CLP Pesticide reporting).	Text	12	NO
LabReportingBatch	Unique laboratory identifier for a batch of samples including associated calibrations and method QC, reported as a group by the lab (i.e., lab work order #, log-in #, or SDG). Links all instrument calibrations, samples, and method QC reported as a group or SDG.	Text	12	NO
PercentRelativeStandard Deviation	The standard deviation as a percentage of the mean used to evaluate initial calibration linearity. Organic methods may use either %RSD or Correlation Coefficient. If applicable, enter the %RSD. Leave this field blank if the Correlation Coefficient is used.	Numeric	5	NO
CorrelationCoefficient	The correlation coefficient resulting from linear regression of the initial calibration. For metals by ICAP, enter '1.0' if a two-point initial calibration was analyzed. Organic methods may use either %RSD or Correlation Coefficient. If applicable, enter the Correlation Coefficient. Leave this field blank if the %RSD is used	Numeric	5	NO
RelativeResponseFactor	This field applies to GC/MS only. For continuing calibration enter the relative response factor. For initial calibration enter the average relative response factor. Refer to comments about initial calibration records in the field description for Alternate_Lab_Analysis_ID.	Numeric	5	NO

Table A2
Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
Percent_Difference (or Percent Recovery)	For organic methods, this field is the difference between 2 measured values expressed as a percentage. If %RSD is reported, enter the % difference between the average response factor of the initial calibration (IC) and the response factor of the initial calibration verification (ICV) or continuing calibration (CCV). If correlation coefficient is used, enter the % difference between the true value and the measured value. The Percent_Difference is expressed as a negative or positive value. Do not express Percent_Difference as an absolute value. Use a negative value if the CCV or ICV response factor is less than the IC average response factor or, in the case of correlation coefficient, the CCV or ICV measured value is less than the true value. Use a positive value if the CCV or ICV response factor is greater than the IC average response factor, or in the case of correlation coefficient, the CCV or ICV measured value is greater than the true value. For inorganic methods, this field is the recovery of an analyte expressed as a percentage of the true amount (i.e., %R for a metal in the continuing calibration or initial calibration verification by Method 6010B).	Numeric	5	NO
PeakID01	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 50, for DFTPP enter 51.	Numeric	10	NO
PercentRatio01	For BFB enter the ion abundance of m/z 50 as a percentage of m/z 95, for DFTPP enter the ion abundance of m/z 51 as a percentage of m/z 198.	Numeric	10	NO
PeakID02	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 75, for DFTPP enter 68.	Numeric	10	NO
PercentRatio02	For BFB enter the ion abundance of m/z 75 as a percentage of m/z 95, for DFTPP enter the ion abundance of m/z 68 as a percentage of m/z 69.	Numeric	10	NO
PeakID03	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 95, for DFTPP enter 69.	Numeric	10	NO
PercentRatio03	For BFB enter the ion abundance of m/z 95 as 100 percent, for DFTPP enter the ion abundance of m/z 69.	Numeric	10	NO
PeakID04	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 96, for DFTPP enter 70.	Numeric	10	NO
PercentRatio04	For BFB enter the ion abundance of m/z 96 as a percentage of m/z 95, for DFTPP enter the ion abundance of m/z 70 as a percentage of m/z 69	Numeric	10	NO
PeakID05	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 173, for DFTPP enter 127.	Numeric	10	NO

Table A2

Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
PercentRatio05	For BFB enter the ion abundance of m/z 173 as a percentage of m/z 174, for DFTPP enter the ion abundance of m/z 127 as a percentage of m/z 198	Numeric	10	NO
PeakID06	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 174, for DFTPP enter 197.	Numeric	10	NO
PercentRatio06	For BFB enter the ion abundance of m/z 174 as a percentage of m/z 95, for DFTPP enter the ion abundance of m/z 197 as a percentage of m/z 198.	Numeric	10	NO
PeakID07	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 175, for DFTPP enter 198.	Numeric	10	NO
PercentRatio07	For BFB enter the ion abundance of m/z 175 as a percentage of m/z 174, for DFTPP enter the ion abundance of m/z 198 as 100 percent.	Numeric	10	NO
PeakID08	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 176, for DFTPP enter 199.	Numeric	10	NO
PercentRatio08	For BFB enter the ion abundance of m/z 176 as a percentage of m/z 174, for DFTPP enter the ion abundance of m/z 199 as a percentage of m/z 198.	Numeric	10	NO
PeakID09	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 177, for DFTPP enter 275.	Numeric	10	NO
PercentRatio09	For BFB enter the ion abundance of m/z 177 as a percentage of m/z 176, for DFTPP enter the ion abundance of m/z 275 as a percentage of m/z 198.	Numeric	10	NO
PeakID10	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 365.	Numeric	10	NO
PercentRatio10	For BFB leave blank, for DFTPP enter the ion abundance of m/z 365 as a percentage of m/z 198.	Numeric	10	NO
PeakID11	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 441.	Numeric	10	NO
PercentRatio11	For BFB leave blank, for DFTPP the ion abundance of m/z 441.	Numeric	10	NO
PeakID12	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 442.	Numeric	10	NO
PercentRatio12	For BFB leave blank, for DFTPP enter the ion abundance of m/z 442 as a percentage of m/z 198.	Numeric	10	NO
PeakID13	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 443.	Numeric	10	NO
PercentRatio13	For BFB leave blank, for DFTPP enter the ion abundance of m/z 443 as a percentage of m/z 442.	Numeric	10	NO

Table A2

Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List

* Date/time format is: MM/DD/YYYY hh:mm where MM = month, DD = day, YYYY = four digits of the year, hh = hour in 24 hour format, and mm = minutes.

Table A3
Field Description for the Sample Analysis (Table A3)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ProjectNumber	Project number assigned by the client.	Text	30	YES (specified by project)
ProjectName	Project name assigned by the client.	Text	90	YES (specified by project)
ClientSampleID	Client or contractor's identifier for a field sample If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the Analysis_Type field is used for this distinction). For example, MW01DL and MW01RE are not allowed Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Sample Analysis table for both EDDs.	Text	25	NO
Collected	For radiochemistry methods the Date of sample collection. Refer to the date format for radiochemistry methods at the end of this table. For all other methods the Date and Time of sample collection. Refer to the date/time format at the end of this table. Leave this field blank for Method Blank, LCS, and LCSD	Date/ Time	16*	NO
MatrixID	Sample matrix (i.e., AQ, SO, etc.)	Text	10	YES (See Table B)
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. There are no restrictions for the LabSampleID except field length and that the LabSampleID must be unique for a given field sample or lab QC sample and method.	Text	25	NO
QCType	This record identifies the type of quality control sample QC (i.e., Duplicate, LCS, Method Blank, MS, or MSD). For regular samples, leave this field blank.	Text	10	YES (See Table B)
ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport client or field samples. Links all samples to a cooler or shipping container. No entry for method blanks, LCS, and LCSD. This field is optional.	Text	25	NO
Temperature	Temperature (in centigrade degrees) of the sample as received. This field is not required for radiochemistry methods.	Numeric	10	NO

Table A3
Field Description for the Sample Analysis (Table A3)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or laboratory identifier for a method such as a SOP number, however; values used for Laboratory Method IDs are specified by the project and must in the in standard value list for method IDs.	Text	25	YES (Specified by the project)
PreparationType	Preparation Method Number (i.e., 3010A, 3510C, 3550C, 5030B, etc.) For analytical procedures that do not have a specific preparation method number, use "Gen Prep".	Text	25	YES (See Table B)
AnalysisType	Defines the type of analysis such as initial analysis, dilution, re-analysis, etc. This field provides distinction for sample records when multiple analyses are submitted for the same sample, method, and matrix, for example: dilutions, re-analyses, and re-extracts.	Text	10	YES (See Table B)
Prepared	For radiochemistry leave this field blank. For all other methods enter the date and time of sample preparation or extraction. Refer to the date/time format at the end of this table.	Date/ Time	16*	NO
Analyzed	For radiochemistry methods the date of sample analysis. Refer to the date format for radiochemistry methods at the end of this table. For all other methods the date and time of sample analysis. Refer to the date and time format at the end of this table.	Date/ Time	*	NO
LabID	Identification of the laboratory performing the analysis .	Text	7	NO
QCLevel	The level of laboratory QC associated with the analysis reported in the EDD. If only the Analytical Results Table (A1) and the Sample Analysis Table (A3) information are submitted for the sample, enter "COA". If the Laboratory Instrument Table (A2) information is also submitted for the sample, enter "COCAL"	Text	6	YES (See Table B)
ResultBasis	Indicates whether results associated with this sample records are reported as wet or percent moisture corrected. This field is only required for soils and sediments. Enter "WET" if results are not corrected for percent moisture. Enter "DRY" if percent moisture correction is applied to results .	Text	3	YES (See Table B)
TotalOrDissolved	This field indicates if the results related to this sample record are reported as a total or dissolved fraction. This field is only required for metal methods. For all other methods leave this field blank.	Text	3	YES (See Table B)
Dilution	Dilution of the sample aliquot. Enter "1" for method blanks, LCS, and LCSD, or if the field samples was analyzed without dilution.	Numeric	10	NO
HandlingType	Indicates the type of leaching procedure, if applicable (i.e., SPLP, TCLP, WET). Leave this field blank if the sample analysis was not performed on a leachate.	Text	10	YES (See Table B)
HandlingBatch	Unique laboratory identifier for a batch of samples prepared	Text	12	NO

Table A3
Field Description for the Sample Analysis (Table A3)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
	together in a leaching procedure (i.e., SPLP, TCLP, or WET preparation). The HandlingBatch links samples with leaching blanks. Leave this field blank if the sample analysis was<u>not</u> performed on a leachate			
LeachateDate	Date and time of leaching procedure (i.e., date for SPLP, TCLP, or WET preparation). Refer to the date and time format at the end of this table. Leave this field blank if the sample analysis was<u>not</u> performed on a leachate	Date /Time	16*	NO
Percent_Moisture	Percent of sample composed of water. Enter for soil and sediment samples only.	Numeric	10	NO
MethodBatch	Unique laboratory identifier for a batch of samples of similar matrices analyzed by one method and treated as a group for matrix spike, matrix spike duplicate, or laboratory duplicate association The method batch links the matrix spike and/or matrix spike duplicate or laboratory duplicates to associated samples. Note, the MethodBatch association may coincide with the PreparationBatch association. The MethodBatch is specifically used to link the MS/MSD and/or DUP to associated samples.	Text	12	NO
PreparationBatch	Unique laboratory identifier for a batch of samples prepared together for analysis by one method and treated as a group for method blank, LCS and LCSD association. The PreparationBatch links method blanks and laboratory control samples (blank spikes) to associated samples. Note, the PreparationBatch association may coincide with the MethodBatch association but the PreparationBatch specifically links the Method Blank and LCS to associated samples.	Text	12	NO
RunBatch	<u>For radiochemistry methods leave this field blank.</u> <u>For all other methods</u> the RunBatch is the unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The RunBatch links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the RunBatch also links a BFB or DFTPP tune. A distinct RunBatch must used with every new initial calibration within a method The value entered in this field links a particular sample/method/analysis type record to a set of associated initial calibration and initial calibration verification records from Table A2. <u>This field is only required if the A2 table is included with the EDD.</u>	Text	12	NO
AnalysisBatch	<u>For radiochemistry methods leave this field blank.</u>	Text	12	NO

Table A3
Field Description for the Sample Analysis (Table A3)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
	For all other methods the AnalysisBatch is the unique identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The AnalysisBatch links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the AnalysisBatch also links the BFB or DFTPP tune. A distinct AnalysisBatch must be used with every new continuing calibration or continuing calibration verification within a method The value entered in this field links a particular sample/method/analysis type record to a set of associated continuing calibration records in the Laboratory Instrument table. This field is only required if the A2 table is included with the EDD.			
LabReportingBatch	Unique laboratory identifier for the EDD. This is equivalent to the sample delivery group, lab work number, login ID, etc. The LabReportingBatch links all records in the EDD reported as one group. The value entered in this field must be the same in all records.	Text	12	NO
LabReceipt	Date and time the sample was received in the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/ Time	16*	
LabReported	Date and time hard copy reported delivered by the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/ Time	16*	

* For radiochemistry methods format Date as MM/DD/YYYY (where MM = two digit month, DD = two digit day, and YYYY = four digit year)

For all other methods format Date and Time as MM/DD/YYYY hh:mm YYYY (where MM = two digit month, DD = two digit day, and YYYY = four digit year, hh = hour in 24 hour format, and mm = minutes)

Table B
Standard Value List

Field Name	Standard Value	Standard Value Description
Analysis_Type	DL	Dilution of the original sample
	DL2	Second dilution of the original sample
	DL3	Third dilution of the original sample
	DL4	Fourth dilution of the original sample
	RE	Reanalysis/re-extraction of sample
	RE2	Second reanalysis/re-extraction of sample
	RE3	Third reanalysis/re-extraction of sample
	RE4	Fourth reanalysis/re-extraction of the original sample
	RES	The initial or original sample.
Analyte_Name	Refer to QAPP and Project Library	Analyte names are specified by the project and entered into the library for each method and matrix. Analyte Names used in project libraries must first exist in the standard value table. The same holds true for the ClientAnalyteID
Analyte_Type	IS	Internal standard as defined per CLP usage
	SPK	Spiked analyte
	SURR	Surrogate as defined as per CLP usage
	TIC	Tentatively identified compound for GC/MS analysis
	TRG	Target compound
Detection_Limit_Type[1]	CRDL	Contract required detection limit
	IDL	Instrument detection limit
	MDA	Minimum detectable activity
	MDL	Method detection limit
Handling_Type[2]	WET	Wet leaching procedure
	SPLP	Synthetic Precipitation Leaching Procedure
	TCLP	Toxicity Characteristic Leaching Procedure
Lab_Analysis_Ref_Method_ID	Refer to QAPP and Project Library	Method IDs are specified by the project and entered into the library. Methods used in project libraries must first exist in the standard value table
Lab_Qualifiers[3]	*	INORG: Duplicate analysis was not within control limits
	*	ORG: Surrogate values outside of contract required QC limits
	+	INORG: Correlation coefficient for the method of standard additions (MSA) was less than 0.995
	A	ORG: Tentatively identified compound (TIC) was a suspected aldol-condensation product
	B	INORG: Value less than contract required detection limit, but greater than or equal to instrument detection limit
	B	ORG: Compound is found in the associated blank as well as in the sample
	C	ORG: Analyte presence confirmed by GC/MS
	D	Result from an analysis at a secondary dilution factor
	E	INORG: Reported value was estimated because of the presence of interference
	E	ORG: Concentrations exceed the calibration range of the instrument
	H	Analysis performed outside method or client-specified holding time requirement
	J	Estimated value
	M	INORG: Duplicate injection precision was not met
	N	INORG: Spiked sample recovery was not within control limits
	N	ORG: Presumptive evidence of a compound
	P	ORG: Difference between results from two GC columns unacceptable (>25% Difference)
	S	Reported value was determined by the method of standard additions (MSA)
	U	Compound was analyzed for, but not detected. Analyte result was below the Reporting Limit.
	W	INORG: Post digestion spike was out of control limits
	X	Reserved for a lab-defined data qualifier
	Y	Reserved for a lab-defined data qualifier
	Z	Reserved for a lab-defined data qualifier
Matrix_ID	AIR	Air
	AQ	Water
	ASH	Ash

Table B
Standard Value List

Field Name	Standard Value	Standard Value Description
Matrix_ID (continued)	BIOTA	Biological matter
	FILTER	Filter
	LIQUID	Non-aqueous liquid
	OIL	Oil
	SED	Sediment
	SLUDGE	Sludge
	SO	Soil
	SOLID	Non-soil/sediment solid
	TISSUE	Tissue
	WASTE	Waste
	WIPE	Wipe
Preparation_Type [4]	3005A	Acid Digestion of Waters for Total Recoverable or Dissolved Metals by FLAA or ICP
	3010A	Acid of Aqueous Samples and Extracts for Total Metals by FLAA or ICP
	3015	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts
	3020A	Acid Digestion of Aqueous Samples and Extracts for Total Metals by GFAA
	3031	Acid Digestion of Oils for Metals Analysis by AA or ICP
	3050B	Acid Digestion of Sediments, Sludges, and Soils
	3051	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils and Oils
	3052	Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices
	3060A	Alkaline Digestion for Hexavalent Chromium
	3510C	Separatory Funnel Liquid-Liquid Extraction
	3520C	Continuous Liquid-Liquid Extraction
	3535	Solid Phase Extraction
	3540C	Soxhlet Extraction
	3541	Automated Soxhlet Extraction
	3545	Pressurized Fluid Extraction
	3550B	Ultrasonic Extraction
	3560	Supercritical Fluid Extraction of Total Recoverable Petroleum Hydrocarbons
	5030B	Purge and Trap for Aqueous Samples
	5035	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
	7470A	Acid digestion of waters for Mercury analysis
	7471A	Acid digestion of soils and solids for Mercury analysis
	Gen Prep	Generic preparation type when a preparation method ID does not exist (used mostly for general chemistry methods)
QC_Level	COA	Certificate of Analysis (accuracy and precision, no calibration)
	COACAL	Certificate of Analysis (accuracy and precision including calibration)
QC_Type	MB	Analytical control consisting of all reagents and standards that is carried through the entire procedure (Method Blank)
	CV	(Calibration Verification) Analytical standard run at a specified frequency to verify the calibration of the analytical system
	CCV	(Continuing Calibration Verification) Analytical standard run every 12 hours to verify the calibration of the GC/MS system
	DUP	A second aliquot of a sample that is treated the same as the original aliquot to determine the precision of the method
	IC	(Initial Calibration) Analysis of analytical standards for a series of different specified concentrations
	ICV	(Initial Calibration Verification) Analytical standard run at a specified frequency to verify the accuracy of the initial calibration of the analytical system
	IPC	(Instrument Performance Check) Analysis of DFTPP or BFB to evaluate the performance of the GC/MS system
	LCS	(Laboratory Control Sample) A control sample of known composition
	LCSD	(Laboratory Control Sample Duplicate) A duplicate control sample of known composition
	MS	(Matrix Spike) Aliquot of a matrix spiked with known quantities and subjected to the entire analytical procedure to measure recovery
	MSD	(Matrix Spike Duplicate) A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method
Reporting_Limit_Type [1]	CRDL	Contract-required detection limit
	CRQL	Contract-required quantitation limit

Table B
Standard Value List

Field Name	Standard Value	Standard Value Description
Reporting_Limit_Type (continued)	PQL	Practical quantitation limit
	SQL	Sample quantitation limit
	RDL	Reportable detection limit
Result_Basis	DRY	Result was calculated on a dry weight basis
	WET	Result was calculated on a wet weight basis
Result_Units [5]	ug/L	Micrograms per liter
	mg/L	Milligrams per liter
	ug/Kg	Micrograms per kilogram
	mg/Kg	Milligrams per kilogram
	pg/L	Picograms per liter
	ng/Kg	Nanograms per kilogram
Total_Or_Dissolved	DIS	Dissolved
	TOT	Total

1 **Additional Detection Limit Types and Reporting Limit Types may be used. These must be added to the application standard values.**
2 **Additional Handling Types (leachate procedures) may be used. These must be added to the application standard values**
3 **Additional Lab Qualifiers may be used, or listed Lab Qualifiers may be used in a different manner than described in this table. New lab qualifiers must be added to the application standard value tables. NOTE: The "U" Lab Qualifier must be used for all non-detects.**
4 **Additional Preparation Types may be used. These must be added to the application standard value tables.**
5 **Additional Result Units may be used. The project library specifies the reporting limit used for each method and matrix**

Note: if new standard values are used then these standard values must be entered in the software standard values for both the lab and contractor. The application will automatically update the standard values tables if an importing library contains standard values (method, client analyte ID, and analyte name) that do not exist in the software importing the new library.

Table C1 (1 of 2)
Required Fields in the Analytical Results Table for GC/MS, GC, and HPLC Methods

	GC/MS Methods			GC and HPLC Methods		
Field	Regular Sample*	MS/MSD	Method Blank, LCS/LCSD	Regular Sample*	MS/MSD	Method Blank, LCS/LCSD
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time	T		T			
Analyte_Type	X	X	X	X	X	X
Percent_Recovery	S	R	R	S	R	R
Relative_Percent_Difference		D	D		D	D
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

Key

- X Required Field
- D Required field for spiked compounds in the LCSD and MSD only
- Q Required field if laboratory has qualified result
- R Required field if Analyte_Type = "SPK" or "SURR"
- S Required field for surrogate compounds only
- T Required field for tentatively identified compounds by GC/MS only
- * Also includes Equipment Blanks, Field Blanks, and Trip Blanks

Table C1 (2 of 2)
Required Fields in the Analytical Results Table for ICAP, AA, and IC Methods

	ICAP and AA Methods			IC and Wet Chemistry Methods		
Field	Regular Sample*	Sample Duplicate, MS/MSD	Method Blank, LCS/LCSD	Regular Sample*	Sample Duplicate, MS/MSD	Method Blank, LCS/LCSD
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection_Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time						
Analyte_Type	X	X	X	X	X	X
Percent_Recovery		S	S		S	S
Relative_Percent_Difference		R	R		R	R
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

Key

- X Required field
- Q Required field if laboratory has qualified result
- R Required field for spiked compounds in LCSD or MSD, or target compounds in the Sample Duplicate only
- S Required field if Analyte_Type = "SPK"
- * Also includes Trip Blanks, Equipment Blanks, and Field Blanks

Table C2
Required Fields in the Laboratory Instrument Table

	GC/MS Tunes		Initial Calibration				Initial Calibration Verification				Calibration Verification, Continuing Calibration
Field	VOA	SVOA	GC/MS	GC HPLC	ICP/AA	IC*	GC/MS	GC HPLC	ICP/AA	IC*	ALL METHODS
Instrument_ID	X	X	X	X	X	X	X	X	X	X	X
QC_Type	X	X	X	X	X	X	X	X	X	X	X
Analyzed	X	X	X	X	X	X	X	X	X	X	X
Alternate_Lab_Analysis_ID	X	X	X	X	X	X	X	X	X	X	X
Lab_Analysis_ID	X	X					X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X	X	X	X	X	X
Run_Batch	X	X	X	X	X	X	X	X	X	X	X
Analysis_Batch	C	C									X
Lab_Reporting_Batch	X	X	X	X	X	X	X	X	X	X	X
Percent_Relative_Standard_Deviation			X	X							
Correlation_Coefficient			B	B	X	X					
Relative_Response_Factor			X				X				M
Percent_Difference							X	X	X	X	X
Peak_ID_01	X	X									
Percent_Ratio_01	X	X									
Peak_ID_02	X	X									
Percent_Ratio_02	X	X									
Peak_ID_03	X	X									
Percent_Ratio_03	X	X									
Peak_ID_04	X	X									
Percent_Ratio_04	X	X									
Peak_ID_05	X	X									
Percent_Ratio_05	X	X									
Peak_ID_06	X	X									
Percent_Ratio_06	X	X									
Peak_ID_07	X	X									
Percent_Ratio_07	X	X									
Peak_ID_08	X	X									
Percent_Ratio_08	X	X									
Peak_ID_09	X	X									
Percent_Ratio_09	X	X									
Peak_ID_10		X									
Percent_Ratio_10		X									
Peak_ID_11		X									
Percent_Ratio_11		X									
Peak_ID_12		X									
Percent_Ratio_12		X									
Peak_ID_13		X									
Percent_Ratio_13		X									

Key

X Required field (some fields are not applicable to some General (Wet) Chemistry tests)

B Required field if reporting best fit

C Required field if BFB or DFTPP associated with a continuing calibration only

M Required field for GC/MS continuing calibration only

*IC Includes Ion Chromatography and Classical or Wet Chemistry methods. Methods such as pH, Conductivity, and others do not use traditional calibration procedures; therefore, some fields marked as a required field under the "IC" column do not apply for these methods.

Table D3
Required Fields in the Sample Analysis Table

	GC, GC/MS, HPLC Methods		ICAP and AA Methods		IC and Wet Chemistry Methods	
Field	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD
Client_Sample_ID	X	X	X	X	X	X
Collected		X		X		X
Matrix_ID	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
QC_Type	X	Q	X	Q	X	X
Shipping_Batch_ID		X		X		X
Temperature		X				X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Preparation_Type	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Prepared	A	A	X	X	N	N
Analyzed	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
QC_Level	X	X	X	X	X	X
Results_Basis		S		S		S
Total_Or_Dissolved			W	W		
Dilution	X	X	X	X	X	X
Handling_Type	L	L	L	L	L	L
Handling_Batch	L	L	L	L	L	L
Leachate_Date	L	L	L	L	L	L
Percent Moisture		S		S		S
Method_Batch	X	X	X	X	X	X
Preparation_Batch	X	X	X	X	X	X
Run_Batch	C	C	C	C	C	C
Analysis_Batch	C	C	C	C	C	C
Lab_Reporting_Batch	X	X	X	X	X	X
Lab_Receipt		X		X		X
Lab_Reported	X	X	X	X	X	X

Key

- X Required field
- A Required field for samples prepared by methanol extraction
- C Required field if Instrument Calibration Table (A2) is included in EDD
- L Required field if analysis performed on SPLP, TCLP, or WET extracts
- N Required field only for samples that require preparation before analysis
- Q Required field for Sample Duplicate, MS, and MSD only
- S Required field if "Matrix_ID" = "SO" or "SED"
- W Required field for aqueous samples only
- * Includes Trip Blanks, Equipment Blanks, and Field Blanks

Vineland Chemical Company Superfund Site
Vibration Monitoring Results, beginning August 04
Contract DACW41-01-D-0001, CF04